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NATIONAL CODE OF ELECTRICAL RULES.

Last week there was brought about the long-sought-for harmony between the electricians and insurance men, which will have a most beneficial result and important bearing upon the question of the proper method of installing electrical wires and apparatus. A brief report of the annual meeting of the Underwriters' National Electrical Association, together with that of the Code Committee of the National Conference on Electrical Rules, will be found in another column of this issue, by which it will be seen that the former has concurred in the suggestions of the Code Committee and adopted with but slight modifications the changes in the rules which the committee has suggested. This co-operation between the insurance and electrical interests, strenuously advocated in these columns as the only proper method of bringing about a satisfactory code, and promulgated by the National Electric Light Association, has produced most promising results. The Underwriters are congratulating themselves on the few changes which the Code Committee suggested in the Underwriters' rules at present in vogue, while the committee is rejoicing in the fact that practically all of its suggestions were accepted by the former, so that the final code should entirely dispose of the misunderstanding and dissatisfaction that has unfortunately existed in the past, and to overcome which was the chief object in calling together a general conference. The code, which is the concrete result of this work, ought to be universally adopted, even if some of its features do not conform to individual opinions, as the paramount advantage of one universal code more than offsets any special objections. Each point has been carefully and intelligently considered, most of the prominent engineers and manufacturers of the country having been consulted, and all having had the opportunity to present their views. It will doubtless be necessary to have various municipal and insurance authorities add special requirements to the national code, but these should be arranged so that the latter shall stand by itself, and as far as possible remain unaffected. Safe wiring in one part of the country is safe wiring in another, and for this reason slight additions only will be rendered necessary by local conditions. Perhaps one of the most far-reaching points considered and provisorily acted upon is the use of plain iron pipes as conduits. It has been urged by many that a lined tube is unnecessary both from an electrical and mechanical standpoint, and that lead-covered wire should not be required when the plain tubing is employed, inasmuch as lead adds little to the mechanical advantages and nothing to the electrical. This latter statement, however, is open to criticism, inasmuch as lead covering prevents the presence of moisture between it and the insulation, while without the covering moisture between the insulation and iron is known to produce deleterious effects. The question therefore remains whether or not a coating can be applied to the interior of the plain pipe which will prevent any tendency to collection of moisture. This point, we understand, will be carefully tested before the rules applying to it are formally adopted. It is, however, but a minor consideration as compared with the necessity of a universal acceptance of a code, which will deal fairly with all interests and not leave to the caprices of inspectors the arbitrary interpretation of its meaning. The National Electric Light Association, the National Conference on Standard Electrical Rules and the Code Committee are to be congratulated upon the splendid results which they have accomplished.

SELF-PROPELLING VEHICLES.

Considerable interest exists in England for the moment in horseless carriages or wagons, and since the "Locomotive-on-Highways Act" went into effect on Nov. 14 last, all reports lead to the impression that the subject of horseless vehicles must be the all-absorbing topic in London at the present time. English experimenters seem to have taken up the subject with a determination to conquer the difficult problems involved, but as yet, judging from all reports, they are hardly as far advanced toward the goal as are Americans. On Nov. 14, to celebrate the innovation of the new law, 54 self-propelled vehicles participated in a race between London and Brighton, a distance of 60 miles. They were operated by steam motors, petroleum motors and electric motors, but according to the most reliable information at hand very few of them were designed or constructed in a manner capable of withstanding the strains such a trip would naturally call upon them to bear. The result was rather ignominious, and of the 54 that started amid much *éclat* only 17 reached their destination; all the others were disabled and fell by the wayside. The promoters of the different types of vehicles, we fear, accomplished more harm than good to the worthy cause. Their carriages were nothing more than skeletons on wheels, endowed with just enough strength to support the motive machinery, and were in no way fitted for practical use. Unscrupulous promoters of new and untried enterprises are liable to do great injury to a good cause by offering the public something impracticable, and this is what the London display amounted to. Many of the leading papers pronounced the whole thing a farce, and suggest a two or three years' course of experimentation before any further attempts are made to offer a horseless carriage for public favor. In this country our engineers and experimenters are progressing with greater caution, and have accomplished some very creditable results. In a recent lecture before the New York Electrical Society, Mr. Joseph Sachs gave some very timely information regarding horseless vehicles. He outlined the requirements of road carriage service and how they could be met in the self-propelling carriage. He placed particular stress upon the importance of a strong yet light construction of vehicle. It seems, however, that most all of the carriages which entered the London-Brighton race were deficient in this respect, thus causing a dismal failure of what was intended to be an epoch-making event. Whatever weaknesses horseless carriages yet possess, there is no doubt but that they will be finally eradicated. That there is a healthy desire in England to foster the production of a reliable horseless vehicle is evidenced by the offer of 1100 guineas in a road carriage competition by the London *Engineer*. The competition is to be international, and four classes of vehicles will be entered; there will also be a supplemental class. The conditions of the contest make a prominent feature of utility and serviceability as respects such vehicles, and there is every reason to hope that this offer will have a wholesome effect on the new industry. This contest will offer an excellent opportunity for American manufacturers to demonstrate to the world what they have done, and we trust that they will make the most of it.

RESISTANCE OF THE ARC

The paper by Messrs. Frith and Rodgers, presented before the London Physical Society, on "The Resistance of the Electric Arc," and concluded in other columns of this issue, is in many respects an abstruse treatment of a most difficult problem. Those who carefully read the paper will doubtless take exception to many of the statements which it contains and question the fundamental conceptions upon which the results are based The method employed of superimposing a small alternating-current upon a direct-current would be pertectly satisfactory if it was demonstrated that its presence would have no appreciable effect upon the counter E. M. F. or resistance of the arc. If such effect exists, however, it will only be by resorting to the instantaneous contact method that accurate results can be obtained. The authors in their paper state that the superimposing of the small alternating-current produced no visible effect in the arc and attempt to substantiate this claim by showing that the resistance of an incandescent lamp may be measured in a similar way by substituting it for the arc. It follows, however, that since the counter E. M. F. of the arc is in all probability a function of the temperature, having undoubtedly a component due to a thermo-electric couple existing between the carbon vapor and the negative electrode, and therefore, not entirely dependent upon the volatilization of the carbon, its value is not constant, but will change with variations in the current. Therefore a small alternating current may produce a comparatively large change in the resistance, thereby making void any assumptions which may be based upon this substitution method. Again, the experiment performed by Mr. Mather would be entirely void if the current in the arc was not maintained constant, a condition not so stated in the paper. The authors carefully point out that the reader must distinguish between the so-called instantaneous $d V / d A$ which is dependent upon the superimposed alternating current, and the steady $d V / d A$ due to the direct current, a fact which has not been considered by several critics. It is also to be noted that the methods of experimenting include in series with the arc a constant resistance, so that the total resistance of the circuit is not negative, but that of the arc is, in their opinion, negative under certain conditions. Thus, no claim is made that a negative resistance can exist alone. The fact, known for several years, that a small increase in the current produces a decrease in the terminal difference of potential may be accounted for on the theory that a thermo-electric couple exists in the arc, apparently, therefore, making it unnecessary to consider the phenomenon as due to a negative resistance. It may be well to call attention to the fact that with a varying applied potential difference the apparent resistance of the arc due to changes of temperature will undergo pulsations, and that it will not be in phase with the impressed E. M. F and current, but will have approximately a maximum value when the current is zero, and a minimum value for a maximum current, so that the resistance will vary through two complete cycles for each complete current period. These resistance variations or pulsations contain upper harmonics of more or less prominence, depending upon the quality of the carbons. Furthermore, as has been pointed out by Prof. S. P. Thompson, we know of no electrical methods by means of which we can discriminate between a constant resistance and a counter E. M F. which is directly proportional to the current, or a constant counter E. M. F. and a resistance which varies inversely as the current. As neither of these latter conditions, if existing in the arc, has been definitely determined, it follows that the correctness of the assumption made by the authors that the superimposed alternating current does not affect the direct current used to maintain the arc is the sole foundation for the reliability of their results It seems also evident that "negative resistance" is a misapplication of terms, and whatever may be the cause for the phenomenon which the authors have investigated, its effect is not to add energy to the circuit. The paper at least introduces some novel and intricate ideas, which make it, if for no other reason than this, worthy of careful study.

As the English See Us.

"Of the making of books there is no end; and much study of them, especially when they are of the technical order and hail from across the Atlantic, is, for the most part, a decided weariness of the flesh." This is the opening sentence in a recent book review as published in our London contemporary, the *Electrician*. It is scarcely necessary to add that the author displays the typical characteristics of English presumption and bias.

The General Electric's Desire to Supply all Motor Equipments.

Following is the full text of the agreement to which the General Electric Company is endeavoring to have street railways consent, in exchange for releases from claims for past infringement of trolley patents and licenses under these patents for the future:

MEMORANDUM OF AGREEMENT between the General Electric Company, a corporation of the State of New York (hereinafter referred to as the company), first party, and..... .....(hereinafter referred to as the "licensee") second party.

WHEREAS, the company owns, or has a license under, a large number of United States patents (including the patents of the Westinghouse Electric & Manufacturing Company) for switches, frogs, trolley crossings, curve constructions, guard wires, cross-wire suspension, trolley ears and clips, suspension insulators, double and single curve suspenders, feeder insulators, section insulators, strain insulators, guard wire holders, and many other devices for use in the construction of the overhead lines used in the system of electrical propulsion, known as the "overhead trolley system," and

WHEREAS, The licensee is using said overhead trolley system in the propulsion of cars upon its lines in the....of...., and is using upon said lines a large number of such devices acquired from various sources, and desires a release from any claim under said patents for the past use of such devices, and also a license under said patents to use and continue the use of such devices upon said lines and extensions thereof;

Now, In consideration of the sum of $1 by the second party to the first party in hand paid, and the mutual covenants herein contained, the parties hereto have for themselves and their respective successors and assigns covenanted and agreed as follows:

First: The licensee is hereby licensed under the patents owned by the company, or under which the company has the right to grant such license, to use switches, frogs, trolley crossings, curve constructions, guard wires, cross-wire suspension, trolley ears and clips, suspension insulators, double and single-curve suspenders, feeder insulators, section insulators, strain insulators, guard wire holders, and such other devices as are covered by such patents, or any of them, in connection with the overhead construction upon the said lines of the licensee or extensions thereof.

Second: With respect to any of the devices of the character covered by this agreement, which the licensee has purchased from the company or may hereafter purchase from it, the company guarantees that the licensee shall not be disturbed in the use of said devices by adverse claims under patents based upon the use thereof, and to that end the company will, at its own expense, defend any and all suits or proceedings that may be instituted against the licensee for the infringement or alleged infringement of any patent or patents, provided such infringement shall consist in the use by the licensee in the regular course of its business of any such devices or parts thereof, and provided the licensee be not in default in his payment therefor, and gives to the company immediate notice in writing of the institution of the suit or proceeding, and permits the company through its counsel to defend the same, and gives all needed information, assistance and authority to enable the company so to do; and thereupon, in case of an award of damages, the company will pay such award, and in case of an injunction against the licensee the company will pay to the licensee any loss or damages to the business caused by such injunction.

Third: So long as the licensee shall use in connection with its overhead system only such car equipments and generating apparatus as it now has in operation, and such car equipments and generating apparatus as it may hereafter purchase from the company, or from some other manufacturer (including the Westinghouse Electric & Manufacturing Company) licensed under the patents of the company, the licensee shall not be required to pay for the license hereby granted any other royalty or consideration than that above specified.

If the licensee shall hereafter, during the life of any of said patents, desire to purchase and shall purchase or operate in connection with its overhead system any motor, controller or car equipment or any generating apparatus not manufactured and sold to it by the company, or by a manufacturer licensed under the patents of the company to make such motors, controllers or car equipments or generating apparatus, as the case may be, then the licensee shall pay, and hereby agrees to pay to the company, as additional royalty for the license hereby granted to use the above patented devices in its overhead line construction, the sum of fifty dollars ($50) for each of such non-licensed car equipments, or for each car having such non-licensed motor or controller and one dollar ($1) for each horse-power (rated capacity) of such non-licensed generating apparatus.

Fourth: Nothing in this agreement contained shall be deemed to grant by implication or otherwise any licenses or rights under any patents except such as are for devices used in overhead construction, and as to such patents only such rights as may be necessary for such overhead construction.

IN WITNESS WHEREOF the parties hereto have caused these presents to be executed by their proper officers, and their corporate seals hereunto affixed this.....day of .....189 .

GENERAL ELECTRIC COMPANY.

The companies which manufacture generators, car equipments, etc., and sell them in competition with the General Electric and Westinghouse Companies, claim that the provisions in this agreement are intended to discourage street railway companies from purchasing apparatus not manufactured by the General Electric or Westinghouse Companies.

It is understood in the trade that street railway managers are opposed to any such agreement as the General Electric has prepared for them, but that as the result orders which might otherwise go to General Electric or Westinghouse are being placed with the Walker and other opposition companies.

There are those who predict that the present efforts of the General Electric as out ined in the foregoing form of agreement are likely to prove almost as unsatisfactory to the company as did its attempt after it secured the lamp decision to prevent the use of incandescent lamps in connection with any except its own machinery.

Engineers and others who are in no wise competitors of the General Electric, and who frankly give the company credit for its good work in the design and manufacture of its apparatus, regret that the company should not have profited from its past experience, and that it should now adopt any course that might interfere with those cordial relations between it and its customers and the trade in general which tend so much to the success of any enterprise.

The Westinghouse Company Wants All the Trolley Orders.

THE ELECTRICAL WORLD has received a copy of the "Overhead Trolley Proposal" form of contract which the Westinghouse Electric & Manufacturing Company asks street railway companies to sign before it is willing to furnish them with "union standard trolleys, trolley bases and parts of trolleys."

This proposal is creating much comment in the electrical trade, and its principal provisions are here given word for word for the benefit of those interested.

The contract begins by saying that "all apparatus covered by this proposal is sold under the patents of the General Electric Company and Westinghouse Electric & Manufacturing Company," and that the company (the Westinghouse) will insure the purchasers "against any possible loss or expense by reason of adverse claims under patents based upon the use of said trolleys or parts of trolleys." the company agreeing to defend suits and pay any damages that may be awarded against the purchaser. The contract continues:

In consideration of the foregoing guarantee, the purchaser agrees that it will not use or permit others to use the trolleys, trolley bases and parts of trolleys, covered or to be covered by this proposal, except when incorporated in and used as parts of such car equipments as it now has, or of such additional car equipments as it may hereafter purchase from the company or from a manufacturer duly licensed under the aforementioned patents (the license of the purchaser to use such trolleys being expressly qualified as in this paragraph provided), and the purchaser covenants not to violate or infringe any of the United States letters patent relative to any of the apparatus hereinbefore specified, controlled by the company or under which the company has the right aforesaid, to manufacture or sell any of such apparatus, nor to contest the company's title thereto, or rights thereunder, or the validity or scope thereof.

All previous communications between the parties hereto, verbal or written, are hereby abrogated, and this proposal, duly accepted and approved, constitutes the agreement between the parties hereto, and no modification of this agreement shall be binding upon the parties hereto, or either of them, unless such modification shall be in writing, duly accepted by the purchaser and approved by an executive officer of the company.

The street railway company in accepting the proposal must "agree that the provisions thereof shall, until written notice from one party to the other, apply to such further purchases of trolleys, trolley bases and parts of trolleys as may from time to time be made by it."

The trade has become accustomed to, even if it does not approve of, the keep-off-the-grass policy of the General Electric with regard to the patents it owns or controls. Street railway companies, however, which purchased Westinghouse equipment in the past, not only on account of its high quality, but also because the Westinghouse was an opposition company, were hardly prepared to believe that one of the results of the patent "understanding" between the General Electric and Westinghouse Companies would be to develop in the stalwart Westinghouse an apparent disposition to follow in the footsteps of the General Electric in adopting methods which the Westinghouse itself at one time vigorously criticised.

Physiological Effects of the Röntgen Tube.

BY W. M. STINE.

No investigator who has pursued this subject with any persistency has failed, probably, to note some more or less marked effects which long exposure to Röntgen tubes have had upon the human body. The literature of observation has grown perceptibly, but that dealing with explanations of a real scientific value has been scant. Allowing for inaccuracy of observation and exaggeration of results, it is apparent that these tubes have caused certain physiological effects with resultant pathological changes. Taken collectively these have been, redness and tenderness of the skin; the skin has become tanned as under exposure to powerful sunlight; the hair has fallen out from the head or hand; swelling and blistering of exposed parts; and in a few cases the inflammation has been followed by suppuration. The significant feature in all the cases has been that the effects did not immediately follow the exposure to the tube, but there elapsed a few days, or as Prof. Elihu Thomson put it, "a period of incubation."

In the earlier days of Röntgen-ray investigations one heard little of such things, and these have become common only since the introduction of the focusing tubes. Nor can such effects be due to more violent excitation of tubes alone, rather than the character of their design, for most investigators are, if anything, employing lower voltage than formerly. Based on the writer's experience, the old type of pear-shaped, glass-intact tubes did not have any permanent effects on the human body, nor were such detected until the focus type was adopted.

In order to obtain a rational explanation for the pathological changes, the attempt will be made to show that they all probably result from one general effect of the Röntgen ray on the body—that of stimulation. This, however, will not directly account for the tanning of the skin. When the tube is placed but a few inches from the skin and kept in that position for at least one half hour, in a few days a discoloration of the skin takes place. The result in all its symptoms seems identical with sunburn, and whether the Röntgen ray be ultra-violet light or not, it is well established that such tubes emit ultra-violet light from secondary actions taking place within them. These actinic rays are capable of producing all the effects which follow exposure to sunlight.

From a medical standpoint inflammation results from an increased local activity of the circulation of the blood. Cohnheim found upon stimulating the tongue and mesentery of a frog that the blood vessels dilated. After a time the white corpuscles lined their walls and began to pass through them into the adjacent tissues. Once escaping from the blood vessels, the leucocytes, through their well known amœboid movements penetrated the tissues. Coincident with the emigration of the leucocytes, the fluid constituents of the blood filtered through the walls of the blood vessels by osmosis. Virchow, another eminent authority claims that in cases where such emigration has occurred the white corpuscles may break down into pus cells.

From some early investigations with Röntgen rays the writer was led to conclude that the immediate and perhaps only effect on the body was one of stimulation, and that this affected chiefly the white corpuscles, causing them to quicken their amœboid movements and emigrations, and possibly their proliferation, the action being in general a tonic one. This certainly accounts for the therapeutic effects which these rays have been found to possess. The view here advanced received striking confirmation when the superficial bodily effects are studied. For example, suppose the hand is held near a powerfully excited tube of the focus type for half an hour. The sensations accompanying the exposure are those of heat and stimulation. In the course of a few days the hand grows red and swells, and perhaps blisters will form, and in some cases suppuration may intervene. Seemingly during the exposure the leucocytes were greatly stimulated and began an emigration through the dilated walls of the blood vessels, venus and arterial. During the latent period, lasting over a few days, these leucocytes permeated the tissues and perhaps proliferated to some extent. Coexisting with these changes an exudation of serum took place, causing swelling. The presence of the leucocytes in the tissues would explain the symptoms of heat and pain in the parts affected. This condition of inflammation would continue until the white corpuscles and serous exudations were absorbed, a process which is always a tedious one at best.

So far this explanation is hypothetical and is worthy of serious attention chiefly from that it is based on certain well established facts connected with similar inflammations produced by other causes. The demonstration must rest with the biologist, and a very inviting field is here presented to him. The final test would be a microscopical examination of amœbæ and leucocytes while under exposure to the Röntgen ray. If the activities of such life-forms were seen to be quickened and their proliferation stimulated, what is here but hypothesis would in all probability become established fact, since the general physiological effects and pathological changes referred to have been fully demonstrated and are generally accepted.

The interesting question would then occur, is such stimulation an immediate effect of the ray due to an absorption of energy, or is it brought about by some chemical change within the cell body, or the fluids in contact with them? And further, to what extent, if any, are the more highly organized tissues stimulated?

National Code of Electrical Rules.

At the annual meeting of the Electrical Committee of the Underwriters' National Electrical Association, held in the rooms of the National Board of Fire Underwriters on Tuesday, Wednesday and Thursday, Dec. 8, 9 and 10, suggestions relating to the changes in the rules of the National Board for safe wiring were considered. The suggestions as to the changes in the rules, which had been sent in on blanks provided for the purpose, in all about 200, were taken up in the order in which they were submitted, and after discussion were acted upon. Many of these suggestions emanated from the Committee on Code of the National Conference on Standard Electrical Rules, a report of which committee's work was published in the issue of THE ELECTRICAL WORLD of Dec. 5. Fortunately the changes were not revolutionary, but several new and desirable rules were added and many amendments were made to improve or make clear existing rules. A number of standard tests of devices and apparatus, such as switches and cut-out blocks, were adopted. Specifications and requirements for the use of plain iron pipe for conduit work were presented and ordered printed and submitted to the electricians present for criticism and suggestions The secretary of the Electrical Committee of the Underwriters' National Electrical Association was instructed in conjunction with some of the gentlemen present to codify the rules as amended and submit the recodification to the committee for approval. The need of rearrangement was strongly brought out at the National Conference meetings, the present code containing repetitions and patchwork as the natural result of its growth. A vote of thanks was tendered to the Committee on Code of the National Conference on Standard Electrical Rules for several very pertinent suggestions offered by its members. A code of rules and specifications for the installation of marine work was reported by the special committee appointed last year, and adopted with certain changes which were rendered necessary by amendments made at the present meeting.

At a meeting held on Friday, Dec. 11, of the Code Committee of the National Conference on Standard Electrical Rules, the action of the Underwriters was presented in detail by several of their officers and prominent members.

Practically all of the Code Committee's suggestions had been adopted, slight verbal changes being made in some cases, and the amendments which had not come from the committee were found to be entirely acceptable, hence, the committee endorsed the entire action of the Underwriters, and will report to the National Conference accordingly. The exact form of the revised rules, which will probably be known as "the National Code," is not yet ready for publication, but will be promulgated as soon as the clerical work is completed.

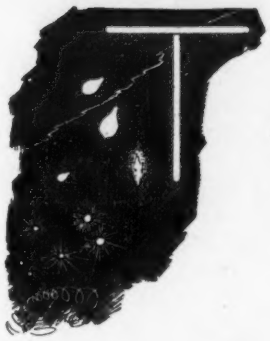
Meeting of the Northwestern Electrical Association.

The fifth convention of the Northwestern Electrical Association will be held at Milwaukee, commencing Jan. 20, 1897. Among the authors and the subjects of the papers which they have consented to present may be mentioned: F. S. Terry, "Incandescent Lamps"; H. C. Wirt, "Protective Devices for Transformers"; Nelson W. Perry, "Gaseous Fuel as a Means of Cheapening Electricity"; O. M. Ash, "Transformers"; Foree Bain, "The Garfield Park Electrical Plant"; Caryl D. Haskins, "Röntgen Ray Phenomena"; George S. McLaren, "Electrical Construction Affecting Insurance"; Prof. W. M. Stine, "Safety Devices for Electrical Circuits," and W. W. Low, "Electrical Supplies." A large attendance is expected, and the above-mentioned authors and subjects warrant the belief that the meeting will be very successful.

Niagara Power Transmission Up to Date.—V.

BY FRANK C. PERKINS.

CURRENT DISTRIBUTION FROM POWER HOUSE.



THE Niagara current as it now leaves the power house is transmitted at three different voltages and three different forms of current. The distribution thus necessitates the use of different kinds of apparatus, different switchboards and different types of measuring instruments.

1. A part of the energy leaves the power house as a two-phase alternating current of 2200 volts difference of potential direct from the large 5000-hp generator seen in the illustration, and is distributed to the consumers on the Niagara Falls Power Company's lands through the conductor bridge and subway. These consumers make such transformation as they think best adapted for their work.

2. A part of the energy leaves the power house as a direct current of 500 volts potential and as such is conducted to the feeder wires of the Buffalo & Niagara Falls Electric Road and the Niagara Falls Electric Street Railway.

3. A part of the energy leaves the power house as a three-phase current at a potential of 11,000 volts and is transmitted by an overhead pole line to Buffalo.

That part of the power which leaves the power house as a direct current at 500 volts for use on the Niagara Falls Electric Railway lines is transformed from a two-phase current at 2200 volts to a direct current of 500 volts by means of static and rotary transformers located in the main power house building at the left near the entrance. The alternating current at 2200 volts is first reduced in voltage by the static transformers, then conducted through the switchboards seen in illustration to rotary transformers and again to the direct-current switchboard to the 500-volt direct-current street railway feeders.

One General Electric rotary transformer—shown in cut—is used in this transformation, and two Westinghouse rotary transformers each of 500-kw capacity are also used for this purpose, making a total of 1500 kilowatts at hand for use on 500-volt circuits. The 500-kw Westinghouse rotary transformer was illustrated in THE ELECTRICAL WORLD of Nov. 21.

The 500-volt direct-current switchboard seen in one of the accompanying views is located at the extreme end of the power house and controls the current supplied for stationary motors, heating the power house, pump motor, commercial motors and feeders of the electric railways.

That part of the energy which leaves the building as a three-phase current at 11,000 volts potential difference, for the Niagara-Buffalo transmission line is transformed from a two-phase current at 2200 volts to a three-phase current, and at the same time raised in potential to 11,000 volts. In order to make the transmission as economical as possible it will be necessary to raise the voltage to 22,000 volts, and this will undoubtedly be done as soon as it is deemed safe to do so and the insulation can be made sufficiently reliable. The two-phase current for this transmission is generated by generator No. 1 (seen in illustration), and is conducted through the subway and conductor bridge (shown in THE ELECTRICAL WORLD, Nov. 2, and Dec. 5) to the transformer house where the 1250-hp static transformers are located. The 2200-volt two-phase alternating current to these static transformers is controlled by the switches mounted on the standards shown in illustration of the raised platform in the main power house. The three-phase 11,000-volt alternating current to the transmission line is controlled from switchboards in the transformer house (illustrated in THE ELECTRICAL WORLD, Dec. 5) across the intake canal.

That part of the energy which leaves the building as a two-phase alternating current at 2200 volts for use on the power company's lands is conducted through the subway directly from the large generator without any change whatever in phase of current or voltage. The current from the large generators is conducted to the subway and to the switches, controllers and measuring instruments on the platform shown in the illustration, the connection being made under the floor of the platform; the doors opening into which are kept closed and locked. Danger signs are placed in view to warn employees of the high-tension current.

The various switches and meters seen upon the platform in the illustration control and measure the current consumed by the various

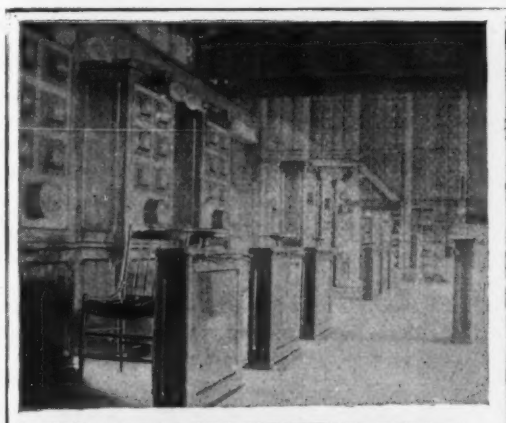


FIG. 1.—INSTRUMENTS AND CONTROLLERS FOR 2200-VOLT 5000-HP GENERATORS.

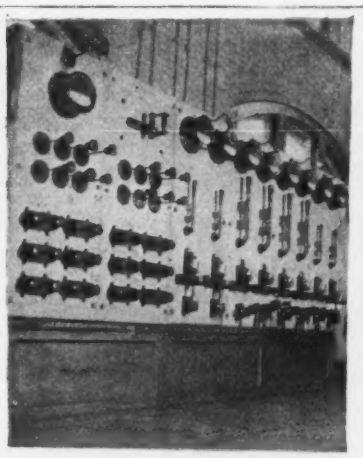


FIG. 3.—500-VOLT DIRECT CURRENT SWITCHBOARD FOR STREET RAILWAYS AND STATIONARY MOTORS.

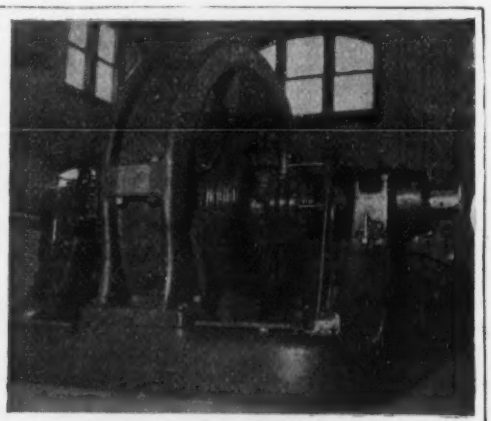


FIG. 5.—G. E. ROTARY TRANSFORMERS IN NIAGARA FALLS POWER HOUSE. DIRECT CURRENT FOR STREET RAILWAYS.

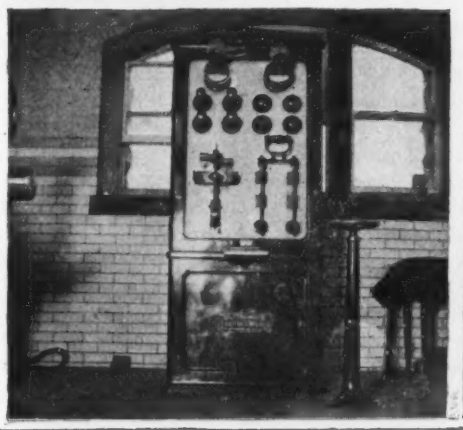


FIG. 2.—500-VOLT SWITCHBOARD FOR CONTROLLING WESTINGHOUSE ROTARY TRANSFORMERS.

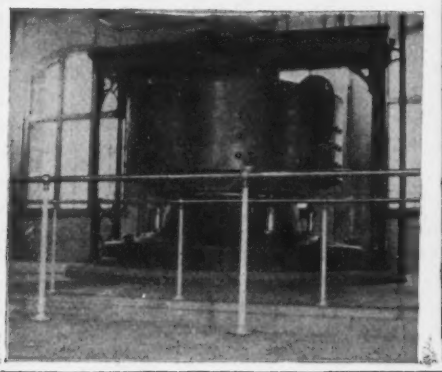


FIG. 4.—GENERATOR FOR BUFFALO-NIAGARA TRANSMISSION.

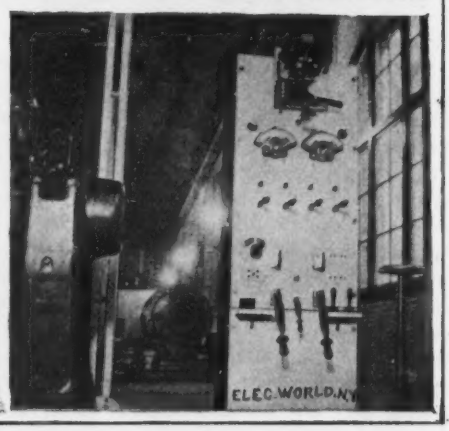


FIG. 6.—500-VOLT SWITCHBOARD FOR CONTROLLING G. E. ROTARY TRANSFORMER.

users on the power company's lands. The Buffalo & Niagara Falls electric light station is supplied with 1000 horse-power from this platform, using the 2200-volt two-phase current, which is conducted directly to the lighting station.

The Carborundum Works use Niagara power to the extent of about 1200 horse-power, transforming from 2000 volts to a low voltage.

On the same feeder wire the Carbide Works receive current for manufacturing carbide of calcium.

The Carbide Works use about 1200 horse-power at 2000 volts direct from the generators with such transformation as is necessary in the works.

The above-mentioned consumers receive their current through cables laid in the subway and are all lead-covered cables. They all have their energy controlled from the switches located upon the raised platform shown in one of the illustrations.

Several new manufacturing plants are about to be constructed using large amounts of electric power, the same to be supplied by the machines now being installed.

Beginning with the city lighting stations the following data may be of interest:

THE BUFFALO & NIAGARA FALLS ELECTRIC LIGHT & POWER COMPANY.

The current for the lighting of the City of Niagara Falls is supplied by the Buffalo & Niagara Falls Electric Light & Power Company, furnishing both arc and incandescent lights. The steam plant consisted of a Reynolds-Corliss engine, 22 by 48, developing about 260 horse-power at 95 revolutions per minute. A Rice automatic engine took care of the day load for light and small power, developing about 100 horse-power at 125 pounds steam pressure.

The electric lighting equipment consisted of Brush arc light machines and Westinghouse alternators for incandescent lights. About 280 street arc lights were used when operated by the steam plant, also 40 private arc lights and 1000 to 1500 incandescent lights.

The Niagara Falls lighting station is now supplied with current to run large induction motors which have replaced the steam engines for driving the arc and incandescent lighting dynamos.

Two induction motors are used, each having a capacity of 500 horse-power, and are operated by the 2000-volt alternating current from the large generators and are giving excellent satisfaction.

The two-phase motor, No. 1, shown in illustration, is belted directly to the large alternator for supplying the incandescent lights while motor No. 2, delivering 500 horse-power, replaces the large steam engine by being belted to the main shaft, from which all of the arc machines are driven.

The problem of power distribution to small consumers is a difficult question to solve, and it is now under consideration by this company and also by the Buffalo General Electric Company and the Cataract Power & Conduit Company. Mr. Chas. R. Huntley, manager of the Buffalo General Electric Company, says the method of distribution has not as yet been decided upon, but that there are two methods under consideration. Inasmuch as there are several thousand horse-power in 500-volt motors now in operation, it would be a hardship for the consumers to throw out their motors and instal alternating machines in their place. For this reason it may be decided to use 500-volt rotary transformers to supply this motor service or drive the present 500-volt power generators in the same way as illustrated above in the Niagara Falls plant, where large Tesla motors replace the steam engines.

Another method which is being considered is to use a 2000-volt alternating-power circuit throughout the city and introducing a small transformer and alternating-current motor wherever power is desired. This plan would undoubtedly be vastly more economical for outlying districts, but the power and lighting company is doing its best to lighten the burden of the consumer by making the first cost as low as possible, and still give the best of service.

THE CARBIDE OF CALCIUM PLANT.

The Carbide Manufacturing Company has just completed another large building which largely increases its plant and allows a much greater production of the carbide of calcium. On account of the great affinity the carbide has for water when acetylene gas is generated, it is necessary to ship the material in air-tight and moisture-tight metallic casks.

The original factory was a brick structure, 40 by 90 feet, and since then two other buildings have been added, one 30 by 60 feet and the other, the large one, just completed. The Carbide Manufacturing Company and the Acetylene Light, Heat & Power Company are the same interests. The two-story building is used for the crushing and grinding machinery. Into the furnace room all of the electric energy obtained from the Niagara Falls Power Company is used except that which runs the 75-hp alternating current motor at 2000 volts for power purposes. This motor operates the grinding and crushing machinery and runs at 350 revolutions per minute.

The carbide of calcium is manufactured by reducing coke and lime by means of the electric current. Coke seems to be best adapted to this work, although other forms of carbon could be used. Quicklime seems to work to better advantage than limestone or slacked lime, although either might be used.

After the coke and lime have been properly mixed and weighed, the electric furnace is charged with the mixture and the current turned on. The furnaces are of brick and contain crucibles of cast iron about three feet long, two feet wide and two feet deep. One electrode is the carbon rod in the centre, while the other electrode consists of the bed-plate. An arc is started between the carbon rod and the bed-plate, and after lengthening the arc the carbide immediately begins to be formed. After the current has been operating two or three hours the carbide is removed and the process repeated after a new charge of the mixture has been made.

The furnaces each use about 500 horse-power and have a capacity of several tons daily. The carbon rods consist of six strips about 4 feet long, 4 inches thick and somewhat less than a foot wide at the lower end, and more than a foot wide at the top. The connection is made to these rods by cast-iron clamps attached to copper rods about 4 inches square. The copper rods are joined to flexible copper cables. The current is supplied to the furnaces, which are connected in parallel, from a 1000-hp transformer, and the current is regulated when the furnaces are started by the use of a reactive coil. The General Electric Company furnished these equipments, and it is the intention to increase the capacity by introducing more furnaces and transformers. Three thousand additional horse-power has been contracted for, together with 10 new furnaces and a new building.

The Carbide Manufacturing Company of Niagara Falls is now turning out five tons of material daily, and is about to increase the present output many times. Carbide of calcium is now used largely for generating acetylene gas, for an illuminant for stereopticons. The light is very white and powerful, and equals the oxyhydrogen, accurately reproducing the subtlest shades and tints. The generators are exceedingly simple to operate, and readily portable. It is certainly safer than oxyhydrogen and other artificial illuminants, and especially is this so as regards the nature of the gas itself, the quantity used and the generator.

The only materials necessary are the carbide of calcium and water. The carbide is only delivered from Niagara Falls in large metallic cases in ton lots, and is shipped to the main office, where it may be bought in small quantities. The absolute ease with which the gas is generated contrasts favorably with the time and trouble that it takes to manufacture oxyhydrogen gases for the lantern. A one-foot burner using acetylene gives more light than six five-foot burners using ordinary gas, the acetylene being equal to 125 standard candles. For use in a lantern a jet with four burners is provided equaling 500 candle-power. The carbide of calcium is a dark crystalline semi-metallic mass, and is very active in the presence of moisture in the production of this acetylene gas.

Two pounds of the carbide is sufficient to operate four 125-cp burners for two hours. In small quantities it costs from 10 to 15 cents per pound. The carbide is placed in the generator, the stop cock is opened and as the air and gas escapes the water rises until it comes in contact with the carbide. Acetylene gas is at once generated and passing around the calcic carbide is dried and the dampness absorbed. Carbide is placed in an annular space around the holder and still further dries the gas. If more gas is generated than is used at once, the pressure of the gas forces the water away from the carbide and generation almost ceases. As the gas is used the generator descends and the operation is repeated, and so the gas is automatically generated as used. There is little doubt that carbide of calcium will be more extensively used in the near future.

CHLORATE OF POTASH WORKS.

The Chlorate of Potash Works are built upon the lands of the Niagara Falls Power Company, and a large amount of power is here used for producing chlorate of potash by electrolysis.

The Chemical Construction Company has a main building 125 feet long and 65 feet wide and two stories high. The current is transformed in another building which is 60 feet long by 40 feet wide. The company's lease calls for eight acres of land, and has at present apparatus for using 500 horse-power, with an option to increase the power to be delivered to 4000 horse-power.

The current is received as a two-phase, alternating at 2000 volts

potential difference, and by means of four static transformers is reduced to a low voltage, and then by two rotary transformers the current is changed from an alternating to a direct current. Each static transformer is about 125 horse-power, while the rotaries are of 250 horse-power each. The energy delivered by the rotaries is 3000 amperes at 60 volts.

The electric equipment was installed by the Westinghouse Electric & Manufacturing Company. The current is conducted to the main building, by ⅜-inch by 5-inch copper bars, 12 in number. The distribution to the pots is made by smaller bars, 4 by ½ inch, in cross section. The pots are 60 in number and are porcelain lined. They are about 8 feet long and about 4 feet wide. Into these pots the chloride of potash or muriate of potash is allowed to pass from a storage tank, which has a capacity for several thousand gallons. When the chloride is decomposed into the chlorate it is transferred to the crystallizing pans. The chlorate of potash is then dried, packed and is ready for shipment.

The chlorate of potash is used largely in the United States and Europe, the consumption running into thousands of tons, the price being in large quantities 9 to 11 cents per ton. Until this plant was started nearly all the supply was imported from European countries.

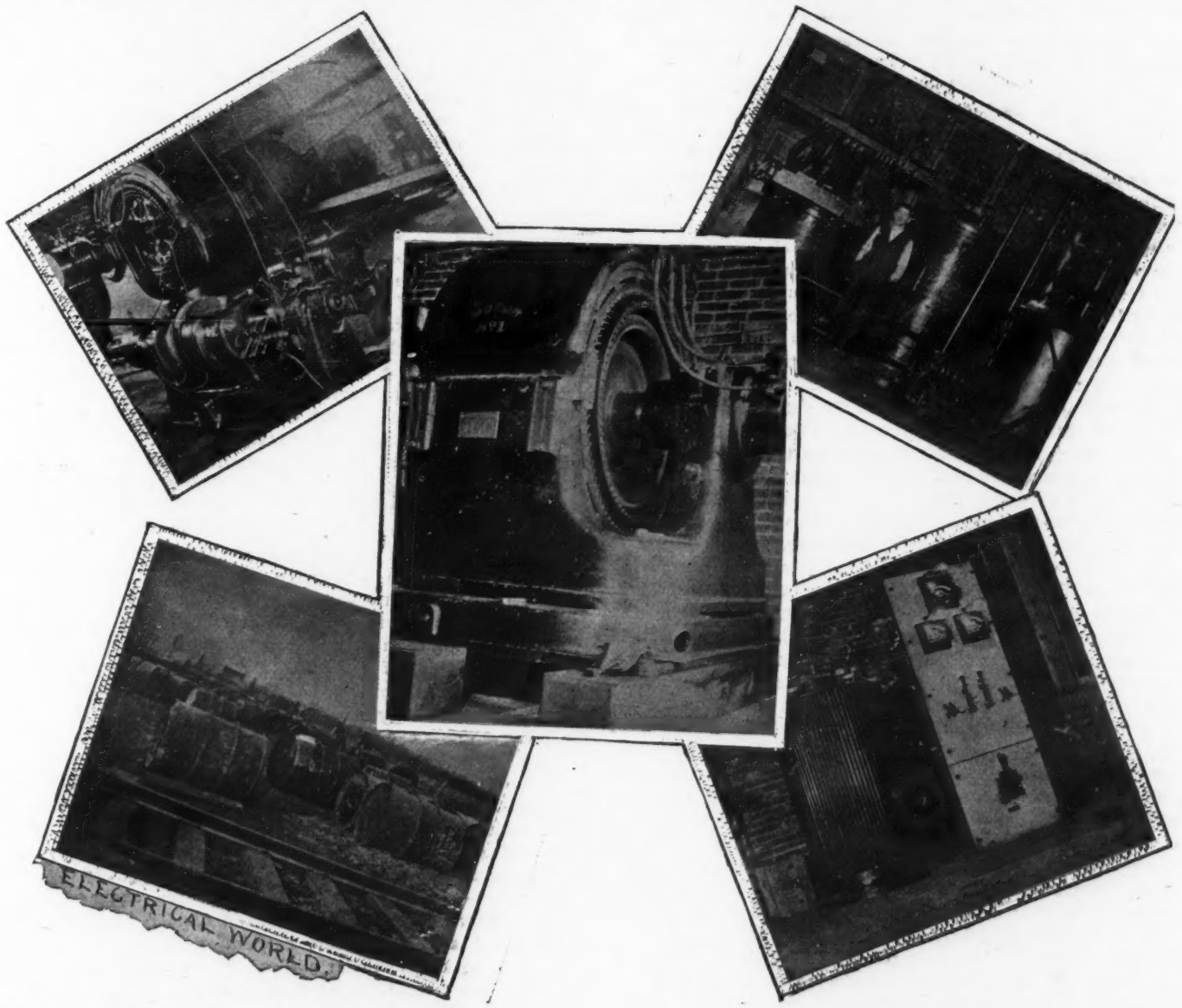


FIG. 7.—500-HP TWO-PHASE MOTOR-DRIVING ARC-LIGHT MACHINES OF NIAGARA FALLS POWER COMPANY.

FIG. 9.—500-HP TWO-PHASE MOTOR IN THE BUFFALO & NIAGARA FALLS ELECTRIC LIGHT PLANT.

FIG. 8.—AIR-TIGHT METALLIC TANKS FOR SHIPMENT OF CALCIUM CARBIDE.

FIG. 10.—2200-185-VOLT TWO-PHASE STATIC TRANSFORMER AND ELECTRICAL OIL PUMP IN CARBORUNDUM WORKS.

FIG. 11.—SWITCHBOARD AND LIGHTING TRANSFORMER IN CARBORUNDUM WORKS.

At present the salts for making chlorate of potash have to be imported.

THE ALUMINUM WORKS.

The next plant using Niagara power is the Pittsburg Reduction Company, which receives its current through the same feeders and subway as the chemical works. A complete description of this plant is to be found in THE ELECTRICAL WORLD of Dec. 12.

THE NIAGARA ELECTRO-CHEMICAL WORKS.

The plant next to the Aluminum Works is the Niagara Electro-Chemical Works, illustrations of which may be seen in THE ELECTRICAL WORLD of Dec. 5. The current used in this plant is received at 2000 volts, and is a two-phase alternating current, controlled by the switches and measured by the instruments shown in the illustration of the elevated platform in the Niagara Falls power house. In this plant four static transformers, each of a capacity of 125 horse-power, reduce the voltage from 2000 down to 118 volts, and after passing the switches and instruments on the switchboard the current is changed in character from an alternating two-phase current to a direct current at a potential of 116 volts. The product turned out at the Niagara Electro-Chemical Works is sodium; and another building for the enlargement of the plant is now in process of erection.

THE CARBORUNDUM WORKS.

The Carborundum Company, of which Mr. E. G. Acheson is president, and Mr. R. B. Mellon is vice-president, was one of the very first companies to use Niagara power.

The current for the manufacture of carborundum does not necessitate a change in character, as the alternating-current is used without the necessity of the use of a rotary transformer for delivering a continuous current. Mr. Acheson is the inventor of carborundum, which is a manufactured product, and is used for many purposes, the principal one being as an abrasive.

The carborundum works is the nearest plant to the Niagara power house. The current is supplied by the large 5000-hp generators shown in illustration, and is controlled from the elevated platform.

The cables through the subway to the carborundum works are lead covered, operated at 2200 volts. The illustrations show a static transformer, inductor or regulator, switchboard and electric oil pump, used in the transformation of this current for use in the furnaces for making carborundum; 1000 horse-power is used in these furnaces. The static transformer reduces the pressure from 2200 volts to 185 volts, and it is kept cool by a continuous flow of oil which is constantly pumped through it by a small pump driven by an electric motor. The regulator is cooled in the same way. The current, after leaving the transformer, passes through the regulator, which varies the voltage as desired from 105 volts to 250 volts. When the current is first supplied to the furnace the regulator is so adjusted as to "boost" the voltage to 250 volts. After the furnace has been in operation a couple of hours and the resistance of the furnace has so decreased as to allow 3000 amperes to flow, then the regulator is used to choke down the voltage so that the power consumed shall not exceed 700 kilowatts and the current is gradually increased to 7000 amperes as the resistance of the furnace decreases until a limit is reached at which it remains nearly constant. When the current is first turned on, no change is noted in the furnace, but after an hour gases begin to come off which, when ignited, burn with a blue blaze. The whole furnace is enveloped in flames toward the end of the run, but little heat escapes, the greater part being used inside in making the necessary chemical change in the charge to produce carborundum.

The resistance of the furnace becomes constant in about four hours and remains so during the balance of the 24 hours, when the current is turned off.

The walls of the furnace are taken down; no change is observed in the outer parts of the mixture. When the current is switched off in the transformer building the flexible cables are disconnected from the bronze plates and another furnace is connected up. The mixture found after the current is switched off has become caked and can easily be pulled off, leaving bare the mass of carborundum which has been formed round the core. When this is removed crystals of carborundum of great beauty are seen. These crystals radiate in lines a foot from the centre. They are all colors; red, green, blue, yellow and violet; most of them are small, but many are large and beautiful hexagonal crystals, some even one half inch across.

The carborundum when removed from the furnace is placed in long tanks and washed with sulphuric acid. After being sifted and arranged according to fineness it is made up into wheels, hones, files, cloth knife sharpeners, etc. Carborundum is used largely in place of emery. Two tons a day are turned out now and the plant has been constructed to accommodate 4000 horse-power in apparatus.

The furnaces are of brick, about 17 feet long, 7 feet wide and 6 feet high, and a good illustration and description may be seen in The Electrical World of Oct. 26, 1895. The interior dimensions of the furnaces are 15 feet long, 6 feet wide and 5 feet high. In the centre of each end wall is a bronze plate to which are connected the cables carrying the current and on the inner surface of the plate 60 rods of carbon are attached each 2.5 feet long and 3 inches in diameter. The charge when ready weighs about 10 tons and consists of a mixture of sand, salt, coke and sawdust. When one furnace has been charged the current is turned on and another furnace is made ready while the current is doing its work. It is said a new factory will soon be built on the Canadian side of the Niagara River, where a large amount of power will be used. Crude carborundum as it comes from the furnace in natural crystals is sold in ton lots at 12 cents per pound. Carborundum grains are numbered the same as emery, the number indicating the threads per lineal inch in the sieve which they pass. Carborundum powders are graded by floating in water. The grains and powders are sold in ton lots at 15 cents per pound. The contract with the Niagara Falls Power Company was for 10,000 horse-power in such quantities and times as might be desired.

MORE NEW MANUFACTURING PLANTS.

A number of local contractors are figuring on bids for the construction of several factories to be erected on the Power Company's lands. Some of these buildings will be erected by the Cataract Construction Company.

The Albright & Wilson Electro-Chemical Company, of Oldbury, near Birmingham, England, will establish a factory on the lands of the Power Company, near the point where the Niagara Junction Railway Company's trestle crosses the Central and Erie roads and Buffalo Avenue. The factory will not require many men, but will use a large amount of power. Their establishment at Oldbury, England, has been in existence a half a century.

Principles of Electrical Distribution.—I.

BY FRANCIS B. CROCKER.

THE distribution of electrical energy from the generating plant to the lamps, motors or other devices in which it is utilized, would seem at first sight to be a simple matter, but in fact, problems of great scientific and technical interest are involved. The designing and laying of a system of electrical conductors to maintain a practically constant pressure throughout a large district requires engineering knowledge and skill of a high order. It is also a fact that in almost every electrical installation the cost of the distributing conductors is a larger item than that of the generating machinery. It might be expected that this would be true of long distance transmission, but it is certainly surprising to find that in an isolated electric lighting plant the wiring is more expensive than the engines and dynamos combined, even where the maximum distance of the lamps from the generators is only a few hundred feet.

Substantially the same principles apply to all branches of electrical transmission and distribution, including electric lighting, power, telegraphy, telephony, etc. But the subject has been developed more extensively and thoroughly in the case of electric lighting, which requires a more nearly perfect regulation of pressure and current than the other applications; hence it is well to study this important subject in connection with electric lighting, which also possesses the advantage of employing practically all the known methods of electrical distribution.

Measuring Electrical Conductors.—Either the Metric system or the ordinary English system of units can be employed to measure the length and size of wires or conductors. The former system, in spite of its many advantages, is rarely used for this purpose in America or in England, and tables or rules employing it would be practically worthless, since they must ultimately be used by common workmen. It should be made compulsory before it can be adopted generally. In English measure we can select either the mile, yard or foot as the unit of length. The first is too large, as it necessitates inconvenient decimal fractions; the yard is often employed in England to measure electrical conductors, but it is rarely used for that purpose in America, the foot being almost universally adopted as the unit. The size of a wire may be either stated in terms of the numbers of an arbitrary gauge, or the actual diameter in fractions of an inch may be given. Unfortunately the practice of using wire gauges has existed from time immemorial, and results in much confusion because of the great number of different gauges.[1] This has been overcome to a certain extent in this country by the general adoption of the Brown & Sharpe, or American wire-gauge, but this is quite different from the Birmingham wire-gauge and from the new Standard British wire-gauge, which are used in England. The American wire-gauge will be employed in the present instance, since in this country wires are made and referred to by that gauge very generally, but in many cases it is much better to specify the actual diameter of the wire. For this purpose the word *mil* has been introduced, being a short name for one thousandth of an inch. That is to say, a wire 100 mils in diameter is one hundred one thousandths or one tenth of an inch in diameter. The cross-section of a wire one mil in diameter is called one *circular mil*, being the area of a circle one thousandth of an inch in diameter. Since the cross-section and conductance of any other round wire will be proportional to the square of its diameter, it follows that the cross-section in circular mils can be found by multiplying the diameter in mils by itself. We thus avoid the difficulty of converting the cross-section into square measure, which requires the square of the diameter to be multiplied by π and divided by four. This is an awkward and unnecessary calculation in the case of round wires, it being much simpler and equally definite to measure them in terms of a circular unit. The cross-section of the rectangular conductors is defined simply in terms of their breadth and thickness in inches or mils.

For measuring wires or conductors, a wire gauge or a micrometer may be employed. The former consists of a plate having slots in its edge corresponding in size to the gauge numbers. The latter is usually a screw-micrometer which measures the diameter or thickness in mils, that is, thousandths of an inch.

Materials for Electrical Conductors.—Copper is the material employed almost universally for electrical conductors, on account of its high conductivity. The slight superiority of silver in this respect is more than offset by its higher density. The conductivity of silver is usually stated to be about 5 per cent. greater than that of copper,

[1] *Wheeler's Chart of Wire Gauges*, The W. J. Johnston Co., Publishers.

but as its density is 10.5 compared with 8.89 for copper, it follows that a silver wire weighs $\frac{10.5}{8.89} \times \frac{1.00}{1.05} = 1.126$ times as much as a copper wire of the same length and resistance. The price of silver per pound would therefore have to fall to 0.889 of that of copper in order to be equally cheap for electrical purposes, and the disadvantage of one eighth more weight still remains.

There are, however, several metals which are lighter than copper for the same resistance. For example, aluminum has a conductivity of 0.542 if copper is taken as unity, and its density is 2.7. Hence, an aluminum wire weighs only $\frac{2.7}{8.89} \times \frac{1.000}{0.542} = 0.56$, or about one half as much as a copper wire having the same length and resistance.[1]

In this connection it is interesting to consider the case of the metal sodium, which has a density of 0.97 and a conductivity of 0.405 of that of copper. Consequently, it weighs only $\frac{0.97}{8.89} \times \frac{1.000}{0.405} = 0.27$, or about one quarter as much for the same length and resistance, so that the cost of the two conductors would be equal if the price of sodium per pound were nearly four times that of copper. It would be entirely impracticable to expose metallic sodium to the air, as it is rapidly attacked by oxygen or moisture, but it could be enclosed in a thin brass or steel tube, and the total weight would still be much less than that of an equivalent copper conductor. While it is a fact that there are several metals that could be used as electrical conductors and which are consid erably lighter than copper, it is doubtful if it would be desirable to use them except in special cases where minimum weight is of particular importance, because their bulk would be so much greater. For example, an aluminum wire must have about twice the cross-section of an equivalent copper wire and would therefore require much more insulating material to cover it and would be more clumsy, either for overhead or underground conductors or interior wiring. Aluminum has been employed as a material for conductors in the aluminum works of the Pittsburg Reduction Company, Niagara Falls,[2] and would seem to be well adapted to this purpose, since it is not necessary to provide the bus-bars with insulating covering, and the fact that aluminum bars would be larger than copper bars is not objectionable in this case, because it tends to reduce the heating of the former.

In addition to metals such as aluminum, which may be employed for electrical conductors in place of copper, because they are lighter, other metals and alloys are used on account of cheapness or greater strength. The most prominent of these is iron or steel, which until a few years ago was adopted almost universally for telegraph and telephone lines. But the most recent practice is to employ copper even for these purposes, it being found that the lower resistance, inductance and capacity (because smaller wires are used) more than makes up for increased first cost. Iron has rarely been used as a conductor in electric light, power or other circuits that carry large currents, because of its much lower conductivity, being about one-seventh that of copper. An iron wire must therefore have seven times the cross section and $\frac{7 \times 7.8}{8.89} = 6.14$ times the weight of an equivalent copper wire, and would cost about as much.

Electrical Resistance.—In electrical distribution, the most important factor is resistance, from the scientific as well as from the commercial points of view. It entirely determines the flow of a direct current, and largely affects alternating current circuits also, necessitating the use of large quantities of copper for conductors, the cost of which constitutes the chief item of expense in almost all electrical plants or systems. In most cases, as already stated, the generating machinery, including boilers, engines and dynamos, costs much less than the copper conductors used in distributing the current.

Resistance appears as a serious difficulty in electrical distribution, since it produces three objectionable effects. First, it causes a *drop* in voltage, so that the various lamps are not supplied with sufficient pressure or with the same pressure; second, it involves a *loss of energy* and efficiency, and third, it produces *heating* of the conductors, which may destroy the insulation or give rise to danger of fire. Each of these effects will be considered separately later.

The determination of electrical resistance can easily be made either by calculation or by actual measurement. It is not necessary here to explain the many well-known ways of measuring resistance, such as the Wheatstone bridge and the fall of potential methods. These may be found in almost any electrical work. Furthermore, it is the usual practice to determine the electrical resistance of conductors in electric light and power distribution by calculation based upon certain recognized standards. This may be verified by tests of samples of the wire or by measurements made after the conductors are laid.

The Standard Conductivity of Copper.—It is almost universally customary to express the comparative conductivity of samples of copper in terms of Matthiessen's standard. Unfortunately Matthiessen gave at different times several values which do not agree exactly, and he also omitted to state the specific gravity of the particular samples which he used. To overcome this difficulty, a committee of the American Institute of Electrical Engineers carefully investigated this question and recommended a general acceptance of a definite value for Matthiessen's standard. It is possible to obtain copper of greater purity and higher density than that used by Matthiessen, so that a somewhat better conductivity can be secured. It seems strange to hear of a conductivity of 102, or even 105 per cent. of the standard, and yet these values have actually been reached. But this objection is not at all serious, since practically all commercial copper is below Matthiessen's standard and no harm results in any case, even if the sample happens to be 1 or 2 per cent. higher, provided the standard itself is perfectly definite and generally adopted.

A complete table was prepared by the committee of the American Institute of Electrical Engineers, giving the resistance, weight, etc., of the various sizes of wire, in both the American and English systems.[3] The resistance of any copper wire at 20 degrees C. or 68 degrees Fahr., according to Matthiessen's standard, may be calculated by the following simple formula: $R = \frac{10.35\,l}{d^2}$, R being the resistance in international ohms, l the length of the wire in feet, and d its diameter in mils. The latter is easily determined with accuracy by means of the ordinary screw micrometer. A very simple and convenient rule to remember is the fact that 1000 feet of No. 10 A. W. G. wire, which is practically one tenth of an inch in diameter (.1019), has 1 ohm resistance at 20 degrees C. (68 degrees Fahr.), and weighs 31.4 pounds. A wire three sizes larger, that is, No. 7, has twice the cross-section and weight per thousand feet, and one half the resistance. A wire three sizes smaller, that is, No. 13, has one half the cross-section and weight and twice the resistance per thousand feet. Another, three sizes smaller, that is, No. 16, has one fourth the cross-section and weight and four times the resistance of No. 10, and similarly a No. 4 wire has four times the cross-section and weight and one fourth the resistance of No. 10. This may be carried to the extreme limits of the gauge in either direction, the cross-section doubling with each three sizes of the gauge. Intermediate sizes may be approximated by interpolation; for example, No. 8 wire is about two thirds larger than No. 10.

(*To be continued.*)

[1] The conductivity of aluminum is sometimes given as high as .60 or even .70.

[2] THE ELECTRICAL WORLD, Dec. 12, 1896.

[3] Transactions, Vol. X., 1893, Supplement.

Is the Berliner Suit Doomed?

The suit of the United States against the Bell Telephone Company, involving the validity of the Berliner patent, occupies the rather unique position of having been practically decided out of court while still in court. The United States Supreme Court, which still has the matter under consideration, has not yet given out any opinion on the subject, but that its decision is likely to be favorable to the Bell interests has been predicted as a natural result of the arguments presented on Nov. 9 last, and this prediction is further supported by the reference made to the case by Attorney-General Harmon in his recent annual report. The Attorney-General sees no prospect of a decision favorable to the Government, and in his opinion the suit should be brought to a conclusion on the best terms obtainable as to costs. The uselessness of the litigation, he says, has become apparent, and he suggests that steps be taken to avoid further waste of money in this direction. During the argument before the Supreme Court, counsel for the Bell Company defied the Government to show a single instance of fraud in intent or act on the part of the Bell Company, and it is upon this point that the defendant seems to have strongly entrenched itself. Taking into consideration, however, the recent developments in this connection, the situation is assuming an interesting aspect and whichever way the Supreme Court may decide the case, the prospects are that the Bell Company will still have to contend with considerable opposition in order to maintain its monopoly.

Insulated Wires and Cables, Their Construction and Design —Insulation; Its Efficiency and Defects.

BY J. DRAPER BISHOP.

(*Continued from page 692.*)

The following process is the only one adopted in this country, and its origin is probably lost in the mists of antiquity. It is nothing more than a modification of the process and machinery in use for ages, whether for making drain pipes, tobacco pipes, garden hose, macaroni, vermicilli, or lead pipe for water service. The writer some years ago handled lead pipe in Pompeii, which, although buried for 1900 years, showed practically no difference from the pipe made to-day, and such joints as were visible were evidently the ordinary "wiped" joint of present use.

Although it is doubtful if the part shown the writer had, in the strict sense of the term, been buried in the soil of what must have been a very filthy city, but perhaps only recovered from the layer of scoria and ashes, which were perfectly dry, and chemically speaking absolutely neutral, still, as it was utilized for conveying water and its path was lost under the ruin, it is but fair to presume that the unseen part was still in good and sound condition.

It is useless, therefore, to say anything more about the permanency of lead covered cables under fair conditions. Of course, under the chemical effect of animal and other acids, ever present in the gas-soaked soil of our modern cities, lead is locally attacked and destroyed it is true, but when laid in iron conduits or in clean or dry ordinary soil it is practically everlasting. Where also lead pipe is placed in conduits of wood, newly treated with creosote, the acid in the oil attacks the lead to a limited extent which is partially if not wholly nullified by the admixture of a small percentage of tin, usually 3 per cent. We shall recur further on to this alloy.

The use of the lead is to achieve two ends; first, to prevent water from reaching the conductor through the insulation, and secondly to prevent this latter from ruination by corrosive or solvent action of foul earth or gas.

The European practice is to call for the usual immersion test of lead covered cable, on the ground that the least crevice or fissure in the lead covering would permit the entrance of water or moisture and thereby ruin the cable. Perhaps this precaution is due to the use of the cold lead press process, in which there seems to me to be a very good chance of a crack or fissure developing under flexion, but in this country such a test is scarcely or never applied, and this course seems entirely consistent with actual experience, as well as the conclusions one would arrive at on a study of the process involved. I cannot say I have never known a fault reported in a cable covered by the hot process. I have known of three in a somewhat severe experience. One was caused by the falling out from the sheathing of a small piece of iron, evidently broken from some part of the press under operation. This, by the bye, occurred in a piece of pipe into which cable was being drawn, and not in pipe being laid new around a cable. Of the other two faults, one I sincerely believe to have been maliciously made, and the third was a long, deep rent or gash in the side of the cable, which, however extraordinary its occurrence may be, certainly was either made during laying or after, for, although laid to the blame of the press, it would have been impossible with ordinary care to have prevented its detection before leaving the press room.

There are millions of feet of lead pipe made and used for household purposes every year. These coils of pipe are accepted by the users by being perfect because they are so, and are never subjected to the commonest kind of a test. As the following description will show, the process of covering lead cables is one in which it would be very difficult if not impossible to get a minute crack or fissure, no matter how much one might want to. The writer by no means contends that it is impossible for a fault of any kind to occur in lead sheathing. It is not only possible, but does occur, seldom, it is true. But, when it does occur it is of such a flagrant and palpable, it even may be of such a dangerous nature, that unless all hands are deaf and blind, detection is unavoidable. It means not only a ragged rupture of the lead pipe or sheath, but possibly of the cable also. The cause of this is that between the charges of lead in the machine "a wait" is necessary to allow the hot fluid metal to cool off on the surface a little. If this wait exceeds a length of time, pure guess work within limits of rule of thumb experience, the lead nearest the die, on exit to the air forms a more or less solid or plastic plug of metal, which has to be expelled before action can occur. Under the pressure of the hydraulic pumps, the ram has to force this plug forward, and like a cork from a bottle the plug flies out, carrying with it or tearing away a part of the sheathing already applied and followed by what is technically known as a "squirt" of fluid metal which in its sprinkling carries no *pax vobiscum* with its contact. Such a "fault" as this being the only one possible, one fails to see the use of an immersion test for lead sheathing as applied in the United States.

The alloy of 3 per cent. of tin with the lead is principally called for by the telephone companies. If only for use in creosoted conduits one might understand its *raison d'être*, but it is difficult to see any advantage when used in iron, terra cotta or glazed enamel conduits. There are hundreds of miles of ordinary lead covered electric light wires underground in perfect order and it seems hard to believe that conditions are more favorable for them than for telephone cables. But the telephone specifications are ordered by men of undoubted skill and intelligence and they doubtless have their own reasons. And the same may be said of the others with perhaps equal justice.

The general belief among all hands connected with cable making is that the 3 per cent. of tin is a snare of the "evil one," and the result of his direct intimation to the telephone powers, that without it cable manufacturers would have too easy a life of it.

Certain is it that that harmless 3 per cent. of tin often is the cause of more dissatisfaction, suspicion and break down, both of temper and machinery, than all other causes combined. And, after all, its utility is doubtful, for there are miles of cable laid in New York to-day in good order, whose condition is laid to the credit of 3 per cent. of tin which it does not in all probability possess.

Tin and lead by themselves are amenable to common sense and one can foresee results, but together they cause results which one cannot always foresee. Lead has a peculiar antipathy to combination with tin, and tin will isolate itself from lead if it possibly can. This peculiarity of tin has led to one worth noting in another art, that of making organ pipes. In the old organs tin was mixed with lead, perhaps to improve the tone, but most probably to give stiffness to the long thin tube. But the tin came to the top of the lead like drops of oil on water, and formed a very pleasing appearance, supposed necessary to good effect musically, and pipes are specified to be made of the best "spotted metal" in Europe if not here, to the present day.

But in cable sheathing this spotted appearance, being an indication that no alloy, only mechanical juxtaposition has occurred, has to be prevented.

The specific gravity of lead is 11.352, while that of tin is only 7.29. Constant stirring together when melted is therefore indispensable, and the employment of various little "dodges" is necessary to equalize as nearly as possible the distribution of this little 3 per cent. of tin throughout the contents of a melting pot containing half a ton perhaps of lead. Besides, the melting point of lead is about 6 2 degrees Fahr., that of tin is only 442 degrees Fahr., while its specific heat is .0514 against .0293 for lead.

In the early days of the 3 per cent. it was not an uncommon thing for all the tin to be at one end of a length of cable, and the writer

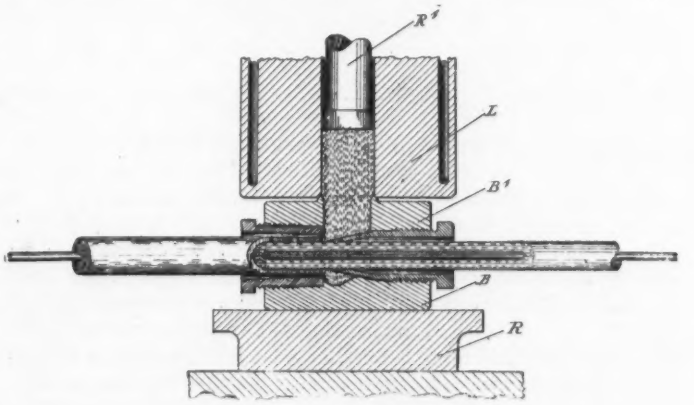


FIG. 10.—LEAD PRESS.

recalls one instance of a coil of cable being analyzed at New York showing tin *nil*, while at Chicago it analyzed "considerably more than 4 per cent.," these conflicting results both being true, the solution lying in the fact that the cable having been uncoiled and recoiled on its drum, the ends had been reversed in position, both sides assuming that the cable was all through similar to the end they had tested.

Besides the difficulty of getting a uniform alloy of lead and tin, the admixture of this little 3 per cent. makes the alloy so hard that

a very much greater pressure is required to work it, and it is no exaggeration to say that more "repair" costs and broken lead cylinders are due thereto, than to all other causes combined. And after all, it seems strange that conditions in one particular direction are supposed to require an alloy uncalled for in any other throughout the whole world of underground work.

One thing is certain, that acids and gases which will attack lead will also attack any alloy thereof. To meet certain well defined conditions such as obtain in creosoted wooden conduits, an alloy of tin may perhaps resist corrosion a little longer than pure lead, but in both it is only a matter of time, while for general use it is abundantly proven that the alloy is worse than useless. It makes the "pipe" hard and stiff, and consequently more easily injured by flexure. The alloy has a peculiar hard and gritty feel when cut with a knife and an unmistakable metallic ring which are absent from pure lead.

Lead weighs about 710 pounds per cubic foot and lead pipe weighs $D^2 - d^2$ 3.86 pounds per foot.

Much enterprise has been expended on attempts to give the lead pipe a coating of tin either on the interior or the exterior or on both, but the mechanical difficulties met with over-balanced the results gained; and no useful or practical advantage has accrued to any one save perhaps a few interested onlookers whose experience thereby has been economically enlarged.

The mechanical process of sheathing cables with lead is very simple in theory, but, notwithstanding, it is one requiring a great deal of technical skill and experienced labor of no common kind,

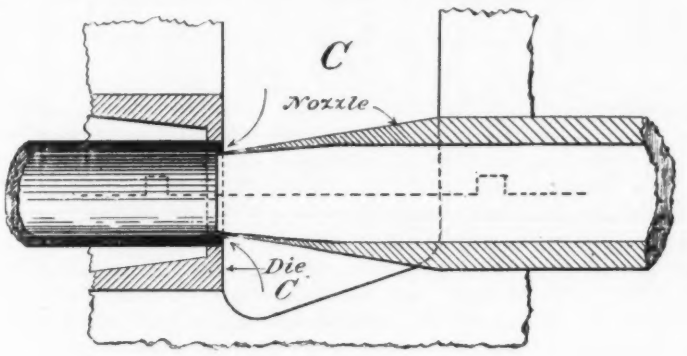


FIG. 11.

although perhaps there is no part of cable-making in which a greater amount of that rough and ready intelligence, best described as "rule of thumb," is brought into requisition.

This will be better understood as we proceed to describe briefly the various steps of the process and the necessary machinery.

The lead in the pig is first melted in an iron pot built in brick over a small coal fire. This pot is provided with a valve worked by a hand wheel, which, being lifted, allows the metal to run into the lead cylinder of the lead press, the upper end of which is open and the lower end closed by the "lead blocks," both cylinder L and blocks B being shown in vertical cross-section in the accompanying illustration, Fig. 10. To facilitate and maintain as uniform a temperature as possible the cylinder is steam-jacketed. It is made of iron of a thickness sufficient to withstand the pressure required to work the lead, on which it will vary from 20 to 30 tons to the square inch, according to the heat of the lead, size of pipe and amount of tin required.

The "blocks" B are two solid masses of wrought or cast iron or steel, brought face to face on a horizontal plane, and pierced through their line of division by holes which are threaded to receive at one side a hollow nozzle or core-bar, and at the other a hollow die. By means of these threads and bolt-headed ends the die or the core-bar may be advanced or withdrawn, thereby determining the thickness of the sheathing. This is easily understood by reference to the second figure, in which both die and nozzle are drawn to a larger scale, and the pipe in course of being made is represented by the solid black. It is well perhaps here to remark that these drawings have no pretensions to accuracy or proportion.

At the point where the die and nozzle intersect, and surrounding both, is a chamber, (C) Fig. 11, excavated from the lower half of the block and cut through the upper one, to allow the supply of lead to pass freely from the lead cylinder into the chamber and out through the die.

The lead is prevented from exit between the blocks by an annular ring and groove turned on the upper and lower meeting faces of the respective halves, shown in dotted lines, Fig. 11, while the upper face of the upper half of the block has turned on it another annular projection of angular cross-section, Fig. 10.

It will be seen that by the angular shape of this "entrance" of the blocks, fitting into the bottom of the lead cylinder, a kind of hydraulic joint is made, by means of which, owing to the whole of the pressure being brought to bear on a small "knife edge" surface, a fit is secured, which is tight enough to effectually prevent the lead from escaping under the enormous pressure used. In Fig. 10 the lead and its path into the "pipe" are shown by the vertical dotted lines, and it may be remarked that a casual glance at the cross-section of the blocks in either figure will show that as both ends are open there is apparently nothing to prevent the molten lead, as it runs into the top of the lead cylinder, from escaping as freely from both ends of the "blocks."

This may of course be prevented by plugging up the ends of the blocks, or at least the nozzle, which indeed is sometimes done, but the difficulty is met in practice in another manner. The lead is only run into the blocks a little at a time, where it is allowed to cool off enough to stop flowing, then a little more is allowed in, and this is repeated until in the judgment of the pressman the blocks are full of lead in a more or less advanced state of solidification, of which his "rule of thumb" judgment and experience is the sole arbiter.

For some two or three hours immediately preceding and during use, Bunsen burner gas jets supplied with air under pressure from a small, steam-driven blower are kept playing on the blocks to heat them sufficiently to prevent the lead from chilling by contact with them. Lead melts at about 610 degrees Fahr., and whether the burners have heated them to 360 or 800 degrees is another point left to be estimated by "rule of thumb," which is but another method of saying that the conditions allow a wide margin for the judgment of the operator. Still these conditions *have* a margin, the limits of which must be left, after all, to the intelligence or intuition of the pressman.

The blocks being in his judgment full, the cylinder is filled to the brim with hot melted lead from the melting pot—and the surface carefully skimmed from any impurities. The press is then set to work, and as the hydraulic ram R is forced upward, carrying with it the blocks B^1 B^1, and the cylinder L full of lead upon them, the lead is brought up against the lead ram R^1 which is immovable, and which fits into the cylinder as shown in the drawing.

So soon as the hydraulic pressure gauge shows a pressure of 50 to 100 tons the press is stopped for a "rule of thumb" period, varying from two to five minutes. This allows a certain amount of cooling off of the lead in the cylinder, while the lead in contact with the lower surface of the lead ram, and which has been considerably chilled thereby, forms a kind of thin washer of solid lead, which effectually closes all means of escape of the hot lead beneath it from the space between the periphery of the lead ram and the interior of the surface of the lead cylinder, which however does not exceed one sixty fourth or one hundredth of an inch. After one or two trials with the gauge the operator "lets her go" for trial.

If the lead is still too fluid a "squirt" will certainly result when once the chilled outer surface of the lead has been forced through the die, and another wait must be allowed to "let her cool down a bit." If, on the contrary, the pressman has been too lavish of his time and the lead has become too cold, it is then a case either of still forcing it out by excessive force at the risk of "something going," or the alternative presents itself of half a day's work in taking the whole arrangement to pieces, which, as the chilled lead has securely cemented blocks and cylinder into a firmly joined mass, is generally only accomplished by the expenditure of much sledging and cutting and "cussing." But fortunately this rarely happens, and presuming on all being well the pressure from the pumps, by means of the hydraulic ram, is made to squeeze out a few feet of pipe from the die end of the block. The lead in the blocks and cylinder is now neither solid nor fluid, but just of the right strength or plasticity to squeeze out like clay, and being just as easy to cut.

A blow from a knife lops off a foot or two, which is cooled in water and handed to the pressman for examination as to concentricity, thickness and diameter. If these are not up to requirement, the position of the die and nozzle relative to the "chamber," or to each other, is altered until the result desired is secured.

(To be continued.)

On the Resistance of the Electric Arc.

BY JULIUS FRITH AND CHARLES RODGERS.

(*Concluded from page 720.*)

The values thus obtained for the resistance of the arc under various conditions are plotted in Figs. 4, 5 and 6. Fig. 4 shows the relation between the resistance of the arc and the current, the P. D. between the carbons being kept constant. Fig. 5 shows the relation between the resistance of the arc and the P. D. between the carbons, the current being kept constant. Fig. 6 shows the relation between the resistance of the arc and the arc length, the current being kept constant. In all these cases the resistance is measured from the central line marked o, positive values above the line and negative values below the line.

Certain makes of carbon have been selected for experiment, namely, Apostle, Brush, Thomson-Houston and Carré carbons, as representative of the various qualities of carbon now in use commercially.

The diameter of the positive carbon was in all cases 11 mm, the diameter of the negative was 9 mm in the case of the Apostle and Brush carbons, 8 mm in the case of the Carré carbons, and 11 mm in the case of the Thomson-Houston carbons. These sizes were selected as being most suitable for the currents we were able to take from our cells. The sizes of the Apostle carbons were those used by Mrs. Ayrton in her experiments.

That the diameter of the carbons used does not have any great effect on the resistance of the arc for the same current and voltage is shown by the curves *D* and *E*, Fig. 4, and Fig. 5. These are the curves for two solid Apostle carbons—one set *D* having carbons 11 mm and 9 mm, and the other set *E* having carbons 18 mm and 5 mm in diameter respectively, and it will be seen that they lie very close together.

On the curves each make of carbon is represented by a particular kind of line as explained in the figure; the Apostle carbons, for instance, are represented by a dotted line. Curves bearing the same letter refer to the same combination of carbons in the different makes. For each make there are four combinations: + cored, — cored; + cored, — solid; + solid, — cored; + solid, — solid; represented respectively by the letters *A*, *B*, *C*, and *D*.

The general characteristics of these curves are that the ordinates of those for + solid — solid are always negative, and those for + cored — cored always positive, while the other curves all lie between these two extremes, those which should have the positive carbon solid always being more negative than those which have the positive cored. The greatest uniformity is met with in the case of the + solid — solid combination, in which all the curves lie close together. For this reason the curves for the Thomson-Houston carbons have been omitted, as they lie completely on the other curves, and would tend to cause confusion. In the case of the cored carbons, however, the uniformity is not so marked, as the material of the core varies largely with the make. In fact, in a single carbon the core may vary considerably, and for this reason the curves for cored carbons are more troublesome to take.

Fig. 4 shows the relation between the resistance of the arc and the current that the arc is taking, the voltage at the carbons being kept constant. It will be noticed that in the case of the combinations which have a solid positive, the number expressing the negative resistance of the arc increases as the current decreases. With the other two combinations—those having a cored positive—the curves for Brush and Carré carbons have the same general characteristics, while those for the Apostle carbon cut these latter. This is probably due to the peculiarities in the coring of the Apostle carbons.

Fig. 5 shows the relation between the resistance of the arc and the P. D. between the carbons, the current being kept constant at 10 amperes in all cases. These curves are more instructive than those in Fig. 4, as the character of the arc alters more with change of voltage than with change of current. As before, the curves for the solid carbons are all very close together. In this case they all show a minimum (maximum negative) value at about 55 volts. With combinations having a cored positive this minimum becomes more strongly marked and occurs at a lower voltage.

It has been our practice to examine the image of the arc on the screen and note when any change in the appearance of the arc takes place. It was first noticed by Mrs. Ayrton that with cored carbons under certain conditions a dark space appeared somewhere near the centre of the arc, dividing the purple glow into two parts. This was never noticed in the case of solid carbons. Our observations have fully confirmed this, and, moreover, we find that the dark space, when only one carbon is cored, is nearer this carbon. We have noted the appearance or disappearance of the dark space, and we find a remarkable coincidence between this point and the minimum of the curves. In the curves for cored carbons in Figs. 5 and 6 to the right of the minimum point the arc always shows a dark space which becomes less marked on approaching the minimum, and at the minimum finally disappears. To the left of this point, although the dark space has quite disappeared, yet the difference in color between the two parts of the globe is still observable, that near the negative carbon being of a redder tint than that near the positive.

Fig. 6 shows the relation between the length of the arc and its resistance at constant current. The general characteristics of these curves are the same as those of Fig. 5, since the length of the arc is roughly proportional to the voltage.

EFFECT OF THE CORE.

Since the presence of a core in either carbon has such a marked influence on the resistance of the arc, we tried the effect of boring out the core of a Carré carbon. The result of using this hollow carbon as the positive is shown by curve *F* in Figs. 5 and 6. It will be seen that this curve follows very closely that obtained with both carbons solid. The effect was now tried of filling this hollow carbon first with plaster of paris, and then with kaolin. In both cases the resistance of the arc so produced was positive. Another effect of these cores was to cause the arc to burn at a much lower voltage for a given current and arc length. The arc was, however, too unsteady to allow of a curve being taken.

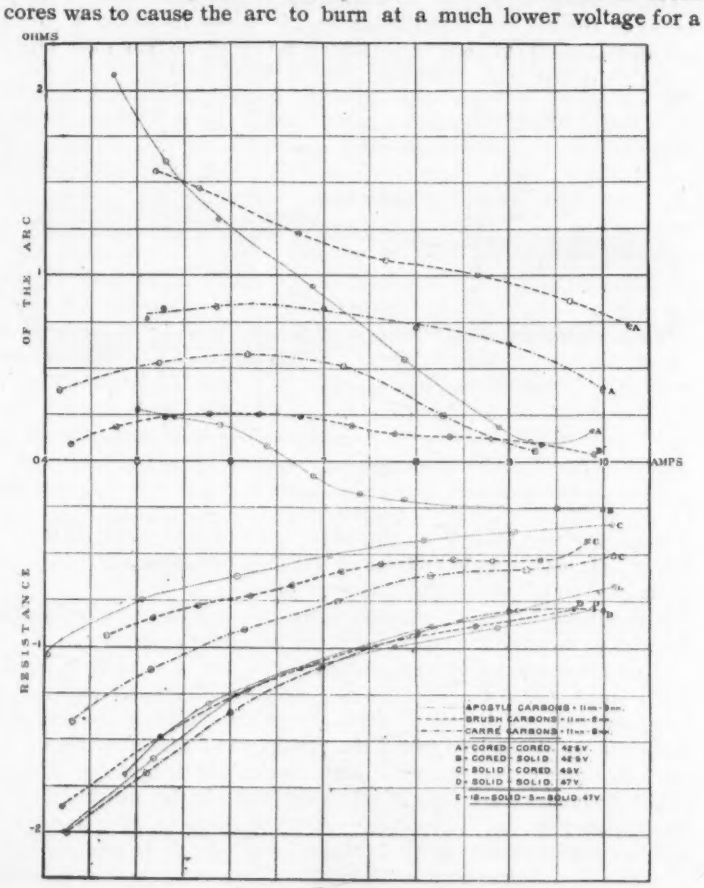

OHMS
2
1
0
-1
-2
RESISTANCE OF THE ARC
AMPS
APOSTLE CARBONS - 11mm - 9mm.
BRUSH CARBONS - 11mm - 9mm.
CARRÉ CARBONS - 11mm - 8mm.
A - CORED - CORED. 42 V.
B - CORED - SOLID. 42 V.
C - SOLID - CORED. 48 V.
D - SOLID - SOLID. 47 V.
E - 18mm SOLID - 5mm SOLID. 47 V.

FIG. 4.

PARTICULARS OF CORES.

The diameters of the various cores are as follows:

Carbon.	Diameter of carbon.	Diameter of core.
	mm.	mm.
Apostle	11	2.7
	9	2.33
Brush	11	2 73
	9	2.18
Carré	11	3.4
	8	1 9

INVERTED ARCS.

In the experiments hitherto described the positive carbon has always been uppermost. Experiments were now made to ascertain if the resistance of the arc is dependent upon whether the positive carbon is the upper or the lower. Using solid carbons, the resistance is

not appreciably altered by inverting the arc. With cored carbons, however, the resistance of the arc is altered, and moreover the physical character of the arc is changed. As we have pointed out above, the distinguishing feature of the arc when using cored carbons is the appearance of a dark space situated near the centre of the purple glow, which appears to considerably increase the resistance of the arc. On inverting such an arc, however, we find that this dark space completely disappears, and, as we should have expected, the resistance is considerably diminished. At low currents or P. Ds., the difference between the resistances of ordinary and inverted arcs diminishes till the two values become nearly equal. These are the conditions under which the dark space ordinarily dis-

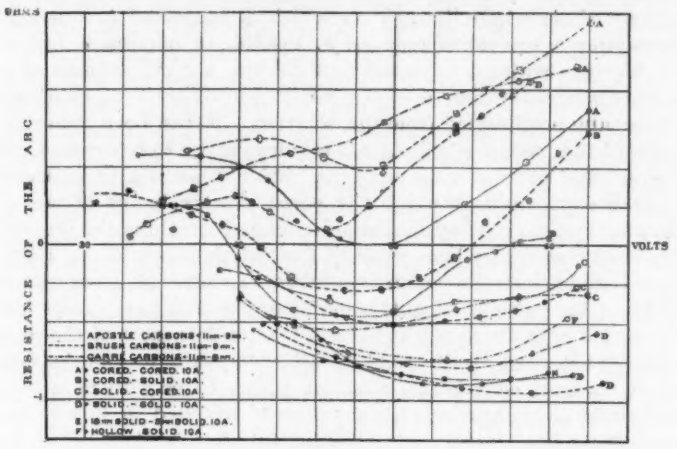

OHMS
RESISTANCE OF THE ARC
VOLTS
APOSTLE CARBONS + 11mm - 9mm.
BRUSH CARBONS + 11mm - 9mm.
CARRÉ CARBONS + 11mm - 9mm.
A = CORED - CORED. 10A.
B = CORED - SOLID. 10A.
C = SOLID - CORED. 10A.
D = SOLID - SOLID. 10A.
E = 10mm SOLID - 5mm SOLID. 10A.
F = HOLLOW SOLID. 10A.

FIG. 5.

appears. Hence when the dark space has disappeared, inverting the arc makes but little difference in its resistance, which is also the case with arcs using solid carbons, in which there is no dark space. By placing the carbons horizontal, a value for the resistance of the arc can be obtained which is intermediate between the two values obtained by placing the positive carbon respectively above and beneath the negative carbon, the current and P. D. being the same in the three cases. From consideration of the part played by the dark space, it would appear that the resistance of the arc is greatly affected by the state of the contact between the purple glow and the negative carbon. When the inside purple glow is in good contact with the negative carbon, the resistance of the arc is most negative. When, however, there is a dark space (caused by the presence of foreign matter or of carbon in a different physical state), and hence a lack of contact between this glow and the negative carbon, the resistance becomes increased.

HISSING ARCS.

An attempt was made, using Method I., to find the resistance of a direct-current hissing arc produced with accumulators, but it was found that even with the alternator at rest there was a large deflexion of the electrometer, showing that *the current through a hissing arc is oscillatory*. In order to determine the frequency of the oscillation, a condenser and telephone were put across the arc. The sound heard in the telephone was, however, of no definite pitch. A method suggested by Mr. Campbell was used to measure the amount of this oscillatory current. The current taken by the hissing arc was passed through the primary of a transformer, the secondary of which was put in series with a reflecting twisted-strip ammeter, the deflection being noted. The arc lamp was then disconnected, and a known alternating current was sent through the primary, of such magnitude that the deflection was the same as before. This known current has the same R. M. S. as the oscillatory current passing through the arc; for if the impedance of the secondary is large compared with its resistance, the deflection of the ammeter is the same for the same R. M. S. current whatever the frequency. The arc was run at 14.5 amperes and 35 volts, Apostle carbons + 9 mm — 9 mm being used. While the arc was burning the deflection of the ammeter varied between 200 and 250 scale divisions. Primary currents of 0.43 ampere and 0.53 ampere, as measured by another twisted-strip ammeter, produced these scale readings respectively. Hence, in this case, the R. M. S. of the oscillatory current amounted to about 3 per cent. of the continuous current.

LOW FREQUENCIES.

On comparing our results with the steady dV/dA taken from the slope of the curves published by Mrs. Ayrton, the agreement as to sign which held in the case of solid carbons, was found to break down in the case of cored carbons; for while the general shape of the curves obtained by Mrs. Ayrton was the same for cored as for solid carbons, that is both curves, except for short arc-lengths, indicated a negative resistance, we find that with both carbons cored the resistance is *always* positive. With a view to elucidating this point, we repeated Mr. Mather's experiments, using both carbons cored, and found the $\delta V/\delta A$ negative as shown by the following table:

Brush carbons.	Both cored
+ 11 mm.	— 9 mm.

Arc taking nine amperes at 43 volts.
Resistance in circuit about five ohms.

Resistance introduced	Volts.	δV.	Amperes.	δA.
+.5	44.8	+1.8	8.10	— .90
+.4	44.2	+1.2	8.30	— .70
+.3	44	+1.0	8.45	— .55
+.2	43.7	+ .7	8.62	— .38
+.1	43.3	+ .3	8.75	— .25
—.1	42.8	— .2	9.20	+ .20
—.2	42.4	— .6	9.38	+ .38
—.3	42.0	—1.0	9.60	+ .60
—.4	41.6	—1.4	9.85	+ .85
—.5	41.1	—1.9	10.08	+1.08

In the curves connecting the P. D. between the carbons and the current, each point is obtained by taking the readings of ammeter and voltmeter after the arc has been made to burn for a *very considerable time* at constant current and arc-length, so that one may say that the "frequency" is zero. In this case, the resistance, if deduced from the slope of these curves, would be negative both for cored and for solid carbons. In Prof. Ayrton's original method, although the readings are taken as quickly as possible, still the "frequency" is small compared with the lowest frequency we have hitherto used, and both the carbons and the arc may have time to alter before the ammeter and voltmeter can be read. This method would lead to the same conclusion as before, *viz.*, that the resistance of the arc is always negative. Our measurements, however, with frequencies as low as 7.5 gave a positive resistance for arcs using cored carbons. Hence it seems that there must be a critical frequency above which the resistance has a positive value which is independent of the frequency, and below which it appears to have a negative value, and further, that this frequency must lie between 7.5 and 0.

Our former methods were not suitable for working with a frequency lower than seven, for at this frequency the needles of the voltmeter and ammeter began to vibrate with the alternating current. This vibration of the needles was made use of in the following way, to indicate the sign of the dV/dA at frequencies lower than seven. The Gramme alternator used in the previous method was run as a rotary transformer. By adjusting the continuous current

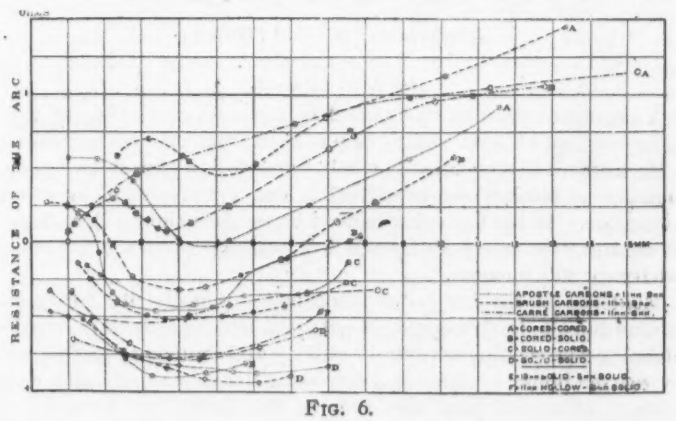

RESISTANCE OF THE ARC
APOSTLE CARBONS + 11mm - 9mm.
BRUSH CARBONS + 11mm - 9mm.
CARRÉ CARBONS + 11mm - 9mm.
A = CORED - CORED.
B = CORED - SOLID.
C = SOLID - CORED.
D = SOLID - SOLID.
E = 10mm SOLID - 5mm SOLID.
F = HOLLOW SOLID - 8mm SOLID.

FIG. 6.

passing through this transformer, and hence its speed, any desired frequency could be obtained down to as low as one complete alternation in two seconds. By an arrangement of mirrors the needles and scales of both ammeter and voltmeter could be observed simultaneously. In this way it could be seen whether the two needles were at any instant vibrating in the same or in opposite directions. It is evident that if the needles are vibrating in phase, that is if an increase of P. D. is accompanied by an increase of current, then dV/dA must be positive; while if they are vibrating out of phase, that is if an increase of P. D. is accompanied by a decrease of current, then it is negative. With this arrangement, *solid carbons at any frequency gave a negative resistance.* With *cored carbons*, how-

ever, we found as we expected, that *above a certain frequency the resistance was positive, while below this frequency the method gave a negative value for dV/dA.* The critical frequency was found by observing the point at which the swing of the needles was uncertain, being sometimes in phase and sometimes out of phase. At this point the frequency was 1.8; at 1.9 the sign was certainly positive, and at 1.7 was negative. This result was obtained with all arcs whose resistance as given by our curves was positive (with one exception mentioned below), and was not obtained with any whose resistance was negative. In the case of arcs whose curves cross the zero line, the transition from positive to negative, as shown by the disappearance of the critical frequency, was well shown and corresponded with the crossing of the zero line. As an example, we ran an arc with Brush carbons + 11 mm cored — 9 mm solid at 10 amperes, the curve for which is marked *B* in Fig. 5. It will be noticed that this curve crosses the zero line twice, at 55 volts and again at 41.3 volts: at 60 volts we found the sign of the dA/dV, as shown by the swing of the needles, to be positive at frequencies above 1.8 and negative below this frequency, at 45 volts it was negative at all frequencies; at 35 volts, however, it was positive at frequencies above 1.8, and also at frequencies *below* 1.8. That the resistance would be positive at all frequencies seemed probable, since the curves connecting the *P. D.* and current at constant arc-length for such carbons show that with small arc-lengths an increase of *P. D.* is accompanied by an increase of current.

The experiments have been carried out in the Physical Laboratory of the Central Technical College, and our best thanks are due to Prof. Ayrton and Mr. Mather for much kind advice during the course of the work.

NOTE.—FLUCTUATION OF THE CURRENT GIVEN BY A CONTINUOUS-CURRENT DYNAMO.

An attempt was made to replace the cells in Method I. by a dynamo, but it was found that even with the alternator at rest the electrostatic voltmeter showed a large deflection. This was evidently due to the oscillation of the current owing to the commutator of the dynamo having a finite number of segments. The oscillation was found to increase as the brushes were moved out of the sparkless position. The dynamo was a 5-kw 2-pole machine, and was giving 10 amperes at 70 volts. By adjusting the brushes to the sparkless position this oscillatory current, measured in the same way as in the case of the hissing arc above, could not be reduced below 2.5 per cent. of the continuous current, while by rocking the brushes out of this position it could be increased to as much as 9 per cent. without the sparking at the brushes being excessive. The commutator was in good condition. This oscillation may introduce errors in the measurement by polarized instruments of the currents given by dynamos owing to the differences between the mean and the R. M. S. of such a current.

Electricity in Gold Milling.*

BY H. M. CHANCE.

That electricity can be applied in some way to effect the rapid, complete and economic extraction of gold from the ores or materials with which it is associated is a belief amounting almost to a conviction among mining men and which is also prevalent among mining engineers. In the following paper I have attempted a classification of the numerous methods by which it has been proposed to use electricity for this purpose.

Evidence of the interest which this use of electricity has created is found in the large number of patented and unpatented inventions claiming the use of electricity in milling and reducing processes, and in the readiness of the engineer, mine manager and mine owner alike to give respectful attention to the claims put forth by the inventors of the processes. The inventors of these processes and appliances have found ready listeners, and have been able to secure the expenditure of considerable sums for the construction of apparatus and for experimenting with their various appliances.

The proposed processes for using electricity in treating gold ores or gold-bearing materials may be divided into six distinct classes, each employing or embodying a different principle or method of using the current.

(1) Electromagnetic; (2) electro-solvent; (3) electro-amalgamating; (4) electro-precipitating; (5) electro-inductional; (6) electro-smelting.

(1) The electromagnetic class of inventions are more generally known as "magnetic separators," and as applied to gold milling aim to mechanically separate articles of magnetic material (such as magnetic iron ore, pyrites or metallic iron) from the grains of gold. This is one of the uses to which Edison and many other inventors first proposed to put their "magnetic separators." The idea is not new, dating back to a period before the invention of the electro-magnet. The various devices belonging to this class of inventions have not come into general or even limited use, probably because there are other equally efficient and more simple methods of effecting this separation.

(2) The electro-solvent is perhaps the most fascinating of all of the proposed methods of applying electricity to the extraction of gold. It usually consists substantially of a proposition to pass a current of electricity through ore which is immersed in a solution containing a solvent of gold—*e. g.*, cyanide of potassium, bromine or chlorine—with the expectation of causing a rapid solution of the gold, which could then be electrically deposited upon the cathode or chemically precipitated from the solution. It has been repeatedly claimed that such methods do not require the ore to be crushed, that the electric current will cause the chemical solvent to penetrate, transfuse or osmose through the pores of large lumps of ore, and thus extract the gold by dissolving it, without crushing the ore. Only the most elementary knowledge of electrolytic action is necessary to cause one to doubt the possibility of these expectations being realized. If all of the particles of gold could by any means be so electrically connected with the anode as to form practically a part of the anode plate, the desired result would doubtless be realized. As the result of all the work done in this direction seems to be without a single successful plant operating on any process included in this class of inventions, it seems exceedingly doubtful whether the electric current can be used in this way.

It may be interesting to note the reported organization of a company to use this process for the extraction of gold *in situ* by boring two series of holes into the ore or gold-bearing formation, the two series to be located some distance apart, one series to be charged with a cyanide or other gold solvent solution, and a current of electricity to be passed through the deposit from one set of bore holes to the other, with the expectation that by electrolytic transfusion the gold solvent solution will be carried through the intervening ore, dissolving the gold, which may then be deposited upon cathodes in the second series of bore holes, or may be extracted by pumping out the solution and chemically precipitating the gold.

(3) The electro-amalgamating class of inventions includes all those processes in which the electric current is used to assist in, or to effect, the deposition of gold on amalgamated plates, or in mercury. It is perhaps the largest class of inventions aiming to use electricity in gold milling. It has been proposed to apply it to almost all forms of gold crushing, milling and concentrating machines, and almost every conceivable kind of gold-saving apparatus has been suggested as suitable for this application of electricity.

The method of application usually consists in passing a current of electricity from some part of the crushing or distributing apparatus, through the water to the amalgamating plates or to the mercury pots or troughs, the idea being that the current will aid in amalgamation, forcing the gold to unite with the mercury or amalgam.

While it is not certain that an electric current has any applicable action of this nature, the current may, if properly distributed, promote amalgamation by keeping the amalgam or mercury surfaces in good order, and it is claimed that the plates can be kept bright and untarnished for an indefinite period by this method. It seems entirely possible that polarization of plates may effect a largely increased saving of gold in working some ores in which amalgamation is retarded or prevented by rapid "sickening" of the plates. It is also claimed that polarization of the plates facilitates the amalgamation of the so-called "rusty" gold. This claim seems worthy of careful consideration, for whether the so-called "rusty" gold owes its qualities (that is, its resistance to amalgamation) to an oxide, sulphide, telluride or other chemical film, or to an electrical or magnetic condition (as an electrostatic charge), or to allotropism, we can readily conceive that the possible effect of the electric current might be sufficient to put such gold in condition for amalgamation. Some years ago a set of electrically connected plates was put to work on the tailings from one of the most successful Western mills, and while these tailings were supposed to contain an extremely small quantity of free gold, the return from these plates was reported to average from $200 to $300 per month. Possibly the chief difficulty in applying electric or electrolytic action to assist amalgamation in appliances used for treating free-milling ores, will be found in the low

* Paper read before the Engineers' Club of Philadelphia.

electrical conductivity of the water, producing currents of such low density at the cathode (amalgamating) surfaces, that fouling of the plates by the local action of some of the constituents of base ores may occur, notwithstanding the polarization of the surface.

(4) The electro-precipitating applications of the electric current are used to precipitate the gold by electrolysis from solutions resulting from some chemical process of treatment. They constitute the most important, being the most numerous and successful applications of electricity in gold milling. South Africa has been the field in which this process of precipitating gold from solution has been most successfully used. It is there known as the Siemens-Halske process, and is a cyanide process, in which the gold is deposited from its cyanide solution by electrolysis.

It is similar in many respects to other forms of electrolytic applications used in plating, refining, etc. The anodes are cast-iron plates, the cathodes are of sheet lead, and when sufficiently coated with gold the latter are removed, melted, and the gold cupelled. About 8,000 square feet of cathode surface is required to electrolize 100 tons of solution in 24 hours. The plates are arranged to act as baffle plates to the solution, which flows slowly though the series. The resulting bullion is of high grade. The process has many advantages over precipitation by zinc shavings, which it has largely replaced. It is, however, evidently best adapted to work on a large scale, and does not seem likely to replace the zinc shaving process at small plants.

(5) The electro-inductional methods proposed for treating gold ores have been devised for use in working alluvial gold or free-milling ores, in which the gold exists in the form of metallic grains or particles. They contemplate the use of high frequency alternating apparatus of various forms, whereby alternating currents are induced in each metallic particle, causing it to be attracted or repelled. The writer is not informed whether any apparatus of this description has progressed beyond the laboratory stage of development. It is claimed that metallic particles can be picked up in this way as readily as magnetic particles are picked up by a magnetic separator. Should these claims be realized in practice this method of separating gold from other materials with which it is mechanically mixed will have a wide field of work, especially in the arid regions, where the absence of sufficient water prevents the use of the ordinary wet methods of separation.

(6) Electro-smelting of gold ores has been repeatedly rejected, as a method too expensive for ordinary ores and as presenting few if any advantages over ordinary smelting practice. That gold can be reduced from its ore by smelting in the electric furnace by a smelting process alone or by a combined smelting and electrolytic process is generally admitted.

Another field for the application of the electric current is in electrolytic refining of base bullion, but this does not properly fall within the limits of the present article, which has aimed only to systematize by classifying the numerous ways in which it has been proposed to use the electric current in separating gold from the ores or materials with which it is associated. This field is a large and inviting one to the electrician and mining engineer alike. That it has not recorded more successful applications is perhaps largely because few electricians or inventors who have devised methods or appliances for this purpose have fully understood the conditions and requirements of milling practice. To succeed with any of these methods of treatment, accurate knowledge is required of the ores, of their chemical and physical peculiarities, and of present processes of treatment, and more especially of the exact causes of the failure of the processes in use to produce satisfactory results.

Effect of Röntgen Rays on the Tissues.

To the Editor of The Electrical World:

SIR:—As further showing the action of the Röntgen rays on the tissues, the two following cases which have recently come under my immediate observation, may be of interest:

The first case is that of a court official in this city who had a bullet somewhere in his head, as the result of administering justice about two years ago. Attempts were made to locate the bullet by means of the Röntgen rays, but without success. As a result, however, the subject suffered the entire loss of hair on the side of his head exposed to the rays.

The second case is that of a prominent attorney here who injured his shoulder in January last. As the patient did not improve as was expected, it was decided to take a Röntgen-ray photograph of the shoulder. Two attempts were made in the latter part of June. One lasted about an hour, and the other on the succeeding day two hours and a half. During the sitting no pain of any kind was experienced. About a week later, however, a slight redness appeared on the shoulder, accompanied by much pain. This gradually increased until the wound looked like a severe burn and covered a space of 12 to 15 square inches. Since this time every attempt to control the inflammatory action has failed.

I agree with Prof. Thomson in ascribing this action of the rays to their chemical activity, and it will be seen that since such rays effect a photographic plate, after passing through a considerable portion of tissue, they may also effect a chemical change within the tissue itself and far from the surface of the skin, causing the most difficult sore imaginable to heal, if not causing a permanent loss of the tissue affected.

I sincerely hope that Prof. Thomson's experience will not prove serious and also that the above noted cases may serve as a further caution.

R. B. OWENS.

UNIVERSITY OF NEBRASKA, LINCOLN, NEB.

Röntgen-Ray Photographs Admitted as Evidence.

A case in which Röntgen-ray photographs were presented as important evidence was brought to trial in the District Court in Denver, Col., Dec. 2. The action was instituted by James Smith against W. W. Grant, of Denver, a physician and surgeon, to recover $10,000 for alleged malpractice resulting, as it is claimed, in the permanent crippling of the plaintiff. As the case is likely to serve as a precedent in many respects in trials in which photographs of this character are offered in evidence, a summary of the facts as they were presented to the court will be of interest.

The plaintiff while at work fell from a ladder, striking on his hip. He consulted the defendant, Dr. Grant, 19 days after the accident. The latter diagnosed the injury as a simple contusion, and his treatment required the exercise of the limb and the swinging of the leg with a weight attached. When the plaintiff consulted other surgeons, they reached the conclusion that the trouble was far more serious than Dr. Grant had found. They agreed that the neck of the femur had been fractured by the fall, and in accordance with this diagnosis the patient should have been advised to lie in bed quietly and give the limb absolute rest. The result of Dr. Grant's treatment is that the left leg is considerably shorter than the right, and the plaintiff is compelled to use crutches. At the trial of the case the plaintiff's attorneys introduced in evidence Röntgen-ray photographs of the injured hip. The negatives were made in the laboratories of the Denver Homœopathic College. It was claimed that the print of the injured hip showed that the neck of the femur had suffered an impacted fracture. In the cross-examination of a witness the attorney for the defendant endeavored to show that photographs of this character were unreliable. The counsel for the defendant moved that the testimony be stricken from the record. He held that photographs could not be admitted in accordance with the principle which has heretofore governed in cases where photographic prints had been offered. The rule was that a photograph was admitted after it had been proved by competent testimony that it represented correctly an object in question. In the case of the Röntgen-ray pictures no one could swear that they represented a hip bone, for example, for the obvious reason that no one had seen it. The attorney for the plaintiff stated that the accuracy of delineations secured by the Röntgen-ray process had been abundantly demonstrated, and supported his assertion by quotations from several recent scientific journals. Judge Le Fevre took the question of admission of the photographs under advisement, and on the following day announced his decision to admit the prints as evidence. The case was still on at the time our correspondent forwarded the above facts.

Acetylene Gas Motor Car.

A firm of Italian engineers has recently constructed some small cars which are propelled by motors driven by acetylene gas, says *The Railway World*, of London. The charge consists of acetylene gas dissolved in 15 times its volume of air, and with this mixture it has been found unnecessary to use water for cooling the cylinders. The method of igniting the charge has not, however, been made known. The motors, it is said, maintain a speed of 600 revolutions per minute throughout a working period of 15 hours. The weight of the motors is only about 20 pounds, so that but a fraction of a brake horse-power is developed. The cost of working is said to be about 12 cents per hour.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Calculation of Dynamos. ARNOLD. *Elek. Zeit.*, Nov. 26.—The beginning of an article on the calculation and examination of single, multiphase and continuous-current dynamos; he praises the recent articles of Rothert and Heyland and develops a method of pre-determining alternating-current machines in which there are some points of difference with the theories above mentioned; such a method must consider the loss of voltage with a change of load or excitation for any given phase difference between the voltage and the current; his method is based on empirical figures, which are determined by simple experiments and which enable one to calculate with great accuracy the effect of armature reaction and magnetic leakage; a table of such values is given.

Non-Synchronous Motors and Wave Forms. ROESSLER. *Elek. Zeit.*, Nov. 19 and 26; a continuation of his long article (see *Digest*, Dec. 5).—An explanation of the results given in the first part, by means of an extension of the theory based on sine curves; the best theory for this purpose is the one developed by Goerges (see *Digest*, Dec. 21, 1895). He then discusses the torque and the heat in the armature; regarding the latter he comes to the conclusion that the power lost in the armature is least when the wave approaches most nearly to the true sine form; a departure from this in either direction increasing the armature heating.

Armature Reaction. HEYLAND. *Elek. Zeit.*, Nov. 19.—A communication in reply to that of Vogelsang, which was noticed in the *Digest*, Nov. 28.

ROTHERT. *Elek. Zeit.*, Nov. 26.—A long reply to the criticisms of Braun, Vogelsang, Behrend and Ziehl, all of which have been noticed recently in these columns. Regarding the theory of Behn-Eschenburg, he states that he is quite familiar with it, and that it is because this theory led to completely incorrect results that he developed his own theory.

Generators and Motors. MITTELMANN. *Elek. Zeit.*, Nov. 19.—The conclusion of his well-illustrated series of articles on the exhibits of the recent Berlin exhibition; the present portion deals with some of the motors and generators of the General Electric Company, of Berlin.

Three-Phase Motors for Reduced Speed. GOERGES. Lond. *Elec. Rev.*, Nov. 27.—A translation of the article abstracted in the *Digest*, Sept. 12.

LIGHTS AND LIGHTING.

Cost of Different Illuminants. E. H. *La Nature*, Nov. 23.—An extract from a recent German publication giving the consumption of each of a number of different illuminants, reduced to a 16-cp lamp; with the figures given, the cost is readily obtained knowing the cost of illuminants at the particular place in question, which cost varies greatly.

Spectra of Solid Bodies. PASCHEN. *L'Eclairage Elec.*, Nov. 21; abstracted from *Wied. Ann.*, 58, page 455.—He discusses the laws governing these spectra; he endeavored to complete by means of a detailed study the work of Langley on the emission spectrum of different bodies, a subject which is of interest in connection with lighting by incandescence.

Interchangeable Electric Signs. WATERS. *Elec. Eng.*, Dec. 9.—A description with numerous illustrations of a system of signs made by a bank of incandescent lamps with which any desired letters may be made up at the will of the operator; there is a keyboard resembling that on the typewriter, the levers being connected with suitable switches.

POWER AND HEAT.

Researches with the Electric Furnace. MOISSAN. Lond. *Elec.*, Nov. 27; abstracted from *Ann. Chemie et Physique*, November.—A brief abstract of three papers giving the results of further researches with silicon, aluminum and certain metallic carbides; in connection with aluminum he points out the important effects of slight impurities.

Refuse Destructor at Leyton. Lond. *Engineering*, Nov. 27.—A well-illustrated description of the one used at Leyton, part of the power from which is used for electric lighting.

Friction Horse-Power in Factories. BENJAMIN. *Eng. News*, Dec. 10.—A reprint of a short paper read before the American Society of Mechanical Engineers, in which he discusses the subject and gives a table of the results of tests of the loss of power by friction in 16 manufacturing establishments in Cleveland; the averages show a loss of 55 to 65 per cent. of the power generated by the engine, varying from about 80 per cent. in one exceptional case to 14.5 per cent. in another.

Water Power. Trans. Am. Soc. Civ. Eng., 1896.—This volume, which has just been published and which contains all the papers read before the Society for the year, contains a paper on "Water Power—Its Generation and Transmission," by WEBBER; electrical transmission is not considered; another by MCELROY on the Caratunk Falls, Me.

TRACTION.

Electric Railways in Europe. Lond. *Elec.*, Nov. 27.—A quotation from recent statistics in a French paper stating that the number of lines in operation have increased from 70 to 111 during the past year and the total length from 437.5 to 564 miles; Germany heads the list with 255 miles and 857 motor cars, France being second with 82.5 miles and 223 vehicles, England third with 67 miles and 168 cars, while Switzerland is fourth with 29.5 miles and 86 cars; Bulgaria and Denmark are the only countries having no lines; of the 111 lines 91 use the overhead trolley system, nine the central rail, eight accumulators and three an underground system.

Railway Through the Sea. Lond. *Elec. Rev.*, Nov. 27.—A well-illustrated description of the railway at Brighton, in which an elevated car travels on submarine tracks; it has been referred to in these columns several times before.

Road Carriage Competition. Lond. *Elec.*, Nov. 27.—A statement of the conditions of the competition under the auspices of the London *Engineer*.

Electrolysis Due to Railway Current. BARRETT. *Elec. Rev.*, Dec. 9.—A reprint in full of his recent report to the City of Brooklyn describing the result of his test and making suggestions; a similar report was made by him two years ago; a map is referred to but is not reproduced; on this map are indicated the points where there is a tendency of trolley currents to flow into the water mains. He suggests that the conductivity of the rails should be reinforced in the most effectual manner possible and to the highest possible degree, but after every advisable effort has been made there will still remain considerable earth currents and the question arises to prevent these from doing damage. Excavations were made in not less than 15 places to examine the water mains, in places there the hydrants showed points of danger; in no instance was any evidence found of corrosion distinctly attributable to electrolytic action; this is discussed in detail; it was found that the cast iron pipes were not attacked, although the wrought iron bolts were seriously injured; there is therefore an apparent preservation of the cast iron pipes, but it would not be warrantable to assert broadly that cast iron of any particular quality possesses an absolute immunity from electrolysis; it is safe, however, to say that for low potentials such cast iron will endure practically unharmed a flow of current into the earth which under the same conditions is totally destructive to wrought iron and lead; wrought iron and lead pipes contiguous to the cast iron water mains were found to be destroyed. If it could be found that some specific fraction of a volt could safely be allowed in the case of cast iron pipes, it would be entirely feasible for the railway companies to reduce the present potentials to a fair standard in nearly every place in the city; the situation regarding the wrought iron and lead pipes or lead cable sheaths is, however, not changed, and they are rapidly being destroyed; every instance of damage will have to be treated specifically, and generally locally; a marked voltage was found to exist in places between the gas pipes and water mains, and he therefore recommends to bond these two systems together by metallic conductors; no water pipe should be allowed to be bonded to the rails without including with it the gas pipe for the same house; there are other places where no method of bonding would be of material advantage, as, for instance, along the river front where the pipes are discharging current toward the river; the only relief here would be to run pipes overhead or to use some material which is not subject to electrolysis. The electrolysis of the water mains in Brooklyn is not nearly as bad as was reasonably to be expected.

Storage Battery Plant in Chicago. West. Elec., Dec. 12.—A note stating that misleading statements in regard to this plant have recently been published (presumably referring to those noticed in the *Digest* last week); the plant at present is in the stage when the power-house machinery and the car-propelling apparatus are beginning to be assembled for installation, and it will be at least 60 days before the plant is in operation; the two cars that are now running are old storage-battery cars that were used on Madison Avenue, New York.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Storage Battery at Manchester. Lond. *Elec. Eng.* and *Elec.*, Nov. 27, and *Lightning*, Nov. 26.—A brief description of the recent addition to the central station; the former journal contains illustrations of the plant. The battery is placed at one mile from the station and is charged from the ordinary mains of the existing five-wire system; a motor gener-

ator is used to raise the voltage at the sub-station from 410 to 590 volts; there are four sets of batteries of 56 cells each, there being 12 regulating cells in each set; the total capacity is 1250 kw-hours; it is thought to be the largest individual battery in the United Kingdom; it carries the whole night load after midnight, dispensing with one shift of hands, and on Sunday it carries the day load in addition to the previous night load.

Coupling Alternators in Parallel. MICHALKE. *L'Eclairage Elec.*, Nov. 21.—An abstract with some of the illustrations of the article noticed in the *Digest*, Sept. 26.

Storage Battery Plants. KLAUDER. *Proc. Eng. Club, Phila.*, November.—A long paper on the general subject of the use of the storage battery in connection with central stations, giving little, if any new matter. He believes that a new era is dawning in electrical practice, due to the more general application of the storage battery, which can no longer be ignored in the design of a station; he shows the various ways in which the accumulator may be used in central stations, and describes one of these more in detail, in which a comparatively small battery is used with the object of working the engines at full load all the time, the battery either receiving or delivering power; the load line for such a system is shown in an illustration and an estimate of the cost is given. He also gives a curve showing the variation of the capacity of a certain type of accumulator, with different rates of discharge, that at eight hours being considered 100 per cent. He considers it impracticable to attempt to completely level the load line by means of accumulators, as the cost of any system of storage would be many times the saving. In conclusion, he calls attention to a few storage battery plants in this country. In the discussion, Christie gives the results of an experiment made to determine the probable saving by the use of a battery plant in connection with a small power station in which the load fluctuates greatly; if the battery can equalize 10 to 20 per cent. of the normal, the mean steam consumed would probably be 16 to 17 pounds per horse-power, whereas now it is 22. Eglin called attention to the large saving in labor by the introduction of a storage battery in central stations; in a certain station this amounted to at least $4000 in a year; Hering pointed out an apparently inconsistent point of inflection in the capacity curve mentioned above, which curve tended to become horizontal at the point where it should fall most rapidly. Keller called attention to the excessive cost of accumulators in this country as compared with the cost in Germany, where they are so largely used.

Paterson, N. J. Elec. Eng., Dec. 9.—An illustrated description of the new light and power station of the Edison Company. There are separate dynamos for the railway work, for the incandescent lighting and for the arc lighting; the railway generators have an output of 3280 amperes, the incandescent light dynamos 6660 amperes, and the arc light equipment consists of 19 machines for 50 lights and 4 for 125. Regarding the economy effected by the combination, it is stated that the improvement in the coal item will be 2.3 pounds per kw-hour, as against 6.9 in the old incandescent station and 4.3 in the old arc light station; one switchboard attendant can handle all three of the systems, and 45 per cent. of the labor can be saved in the current production.

Portable Lighting Plant. West. Elec., Dec. 12.—An illustrated description of the plant used for one of the large traveling shows; it is said to be perhaps the largest and best-equipped of its kind in existence, having a capacity of 56 arc lights of 2000 candle-power. It includes two duplicate wagon plants, each equipped with a boiler, engine and dynamo, the poles and line equipment being carried on a third wagon; it takes two hours to erect the plant and 45 minutes to take it down and pack it; the arc lamps are run on alternating circuits from the two plants, so that in case one of them fails half the number of lights will still be kept burning.

WIRES, WIRING AND CONDUITS.

Calculations of Wires. ROUTIN. *L'Eclairage Elec.*, Nov. 21.—He considers the case of a network of wires for the transmission of energy under the supposition that the efficiency is given, a case which arises frequently in practice; the Thomson law in such a case can be applied only when the loss is less than the given limit; for the other cases he gives the direct solution; he considers the most general case as applied to alternating currents, and includes under the losses those in the primary circuit, the transformers and the secondary circuit. From this he deduces the following law: Having given a network in which there is to be a given loss, the distribution which will give the losses for the most economical conditions requires that the density of the current be constant. In a similar way Bochet (see *Digest*, July 18, Aug. 1 and 15,) studied the case of a network for lighting from which he drew the following conclusions: When the loss of voltage at the extremities of the lines is a given quantity, the most economical distribution of the losses in the lines requires that the density of the current be proportional to the square root of the current.

Loss of Voltage in Triphase Circuits. RODET. *L'Ind. Elec.*, Nov. 25.—In a previous article (see *Digest*, Aug. 24, 1895) he shows that the loss of voltage in the lines of a three-phase circuit, in which the resistance and the loads are equal, is practically independent of the phase shifting; in the present article he discusses the loss of voltage in a single conductor, that is he considers the more general solution of the problem; he uses the method of projections and gives a table of calculated quantities for facilitating such calculations; his formulas enable one to calculate the voltage at the distant end of each of the three lines from which the differences in voltages can be determined. The article is accompanied by a number of examples.

Tension and Sag in Overhead Lines. SCHENKEL. *Elek. Zeit.*, Nov. 19.—He discusses the effect of the temperature on the sag and tension of suspended lines; two solutions have been published but are not satisfactory; the present article attempts to meet these deficiencies. He assumes that the curve is that of a parabola; one of the well-known formulas gives incorrect results because the elongation due to the elasticity of the wire is not taken into account; such formulas may be sufficient for telegraph and telephone lines but are not so for trolley wires with which greater accuracy is necessary; the problem in that case is to make the sag as little as possible without exceeding the limiting tension in Winter; his formulas are not complicated.

Manufacture of Wire. PERRINE. *Elec. Eng'ing*, December.—A long article on india rubber and the insulation of wire with it, concluding with the subject of the armor or protecting lead sheathing.

Table of Cable Capacities. West. Elec., Dec. 5.—A reprint of the underwriters' table as published recently by the National Board.

ELECTRO-PHYSICS AND MAGNETISM.

Röntgen Phenomena. BUGUET. *L'Ind. Elec.*, Nov. 25, and *L'Eclairage Elec.*, Nov. 14; a reprint of an Academy note.—It is known that X-rays will pass into the space behind the disc, even when this disc is sufficiently opaque to completely protect the photographic plate if placed immediately over it; when the photographic plate is placed some distance away from the disc a sort of fringe will be produced around the shadow; by varying the distances and making the exposure sufficiently long, he has been able to get an impression over the whole photographic plate; when a series of pins was stuck into the disc perpendicularly shadows of them were obtained, all of which were directed from the centre to the periphery; from this he concludes that the rays are not bent around the edge of the disc, for if they were the shadows of the pins would be directed from the periphery toward the centre; he also states that the disc could not have been considered as transparent, as blocks of various thicknesses placed on the disc showed no traces on the plate.

Effect of X-Rays on the Skin. C. E. G. *La Nature*, Nov. 28.—After giving an account of the experiences of an X-ray demonstrator at a recent exhibition, he suggests that the cause might be due to the decomposing action of the X-rays on the gases which they traverse; if the action is the same on the liquids of our organism, acid or alkaline substances should be set free, the quantity of which would be very small, but their effect should be to completely disorganize the tissues; he thinks it may be due to this phenomenon that the different actions of the X-rays on bacilli may be attributed; if the rays act after inoculation it surrounds the bacilli with a medium which destroys or dilutes them, but in cultures these destructive media are not produced, and there is therefore no action; this might explain why some observers have found such actions, while others have obtained negative results.

X-Rays in Anatomical Researchs. REMY and CONTREMOULINS. *L'Ind. Elec.*, Nov. 25.—A reprint of an Academy note describing some recent applications of X-rays to cadavers; for studying the vascular system they inject a mixture of metallic bronzes and sealing wax dissolved in alcohol; to bring out the effect of the different depths they use the stereoscope, with which they have obtained good results.

Röntgen Rays on Paleontology. LEMOINE. *L'Ind. Elec.*, Nov. 25.—A reprint of an Academy note, in which he describes researches with fossils; it appears that the rays traverse readily through the fossilized bones; considerable detail was shown.

Electric Resonance. DOMALIP and KOLACEK. *L'Eclairage Elec.*, Nov. 14; abstracted from *Wied. Ann.*, Vol. LVII., page 731.—They describe experiments made with the Tesla apparatus in connection with a Wimshurst machine; the capacity and the self-induction of the primary circuit were varied and in each case the maximum sparking distances for the secondary sparks were measured; for a given capacity these distances pass through a maximum if the self-induction and the primary is varied continuously; according to the magnitude of the capacity the secondary spark can attain 3, 10 and even 17 times the length of the primary spark. This is followed by a development of the theory; in practice the conditions of the theory are not realized exactly, as for instance, that the capacity in the scondary circuit is not localized, but is extended over the wire; the experimental results, however, agree sufficiently well with the theoretical, especially when the secondary sparks are short. They believe to have demonstrated by their experiments that the sparking distance depends on the difference of potential alone and not on a law according to which it varies with the time.

Contact Electricity. NERNST. *Zeit. f. Electrochemie*, Nov. 20.—An extract of some length from a report which he was asked to make to a recent meeting of natural scientists; the report itself is published as a supplement to the *Wied. Ann.*, No. 8; he refers chiefly to the potential differences between liquids and between metals and liquids; he discusses the experimental method for determining the potential difference, the theoretical calculation of the contact-potential and the application of the osmotic theory to electrocapillarity.

Electrolytic Thermo Couples. Duane. *Proc. Lond. Phys. Soc.*, November; abstracted from the *Berl. Ber.*, 39, page 967.—A study of a number of cells.

Thermo-Electric Elements of Amalgams and Electrolytes. Hagenbach. *L'Eclairage Elec.*, Nov. 21.—An abstract of the article noticed in the *Digest*, Nov. 28.

Theory of Moving Electrons and Electric Charges. Larmour. *Proc. Lond. Phys. Soc.*, November.—The beginning of a reprint in full of the paper noticed in the *Digest*, Aug. 22.

Electric Current Due to Magnetic Flux. Braun. *Proc. Lond. Phys. Soc.*, November; abstracted very briefly from a German publication.—As an electric current produces a magnetic flux in a magnetic body, a magnetic flux should produce an electric current in a conductor or polarization in a dielectric; he illustrates this statement by a simple experiment, in which "an iron spiral is placed between the poles of an electromagnet; along the axis of the spiral and through holes in the iron core passes a copper wire, which is connected to the terminals of a galvanometer; on making the current of the electromagnet the iron wire becomes spirally magnetized, and in consequence a current is produced along the copper wire."

Earth's Magnetism in the Eighth Century B. C. Folgheraiter. Lond. *Elec.*, Nov. 7; a brief abstract from *Atti dei Lincei*, No. 8.—A record of his completed researches; he endeavored to discover the magnetic dip at the time of Romulus by examining the present magnetization of Tuscan vases, which must have been fired while standing, thus becoming permanently magnetized in the direction of the earth's magnetic force owing to the impurities in the clay; he found that the north-seeking pole of these vases dipped from 25 degrees above to 25 degrees below the horizon, but never more than that. From this he concludes that the dip was entirely different at that time, its present value at Florence being 60 degrees; he believes that the needle pointed a few degrees above the horizon in the eighth century B. C., and that it was horizontal a few centuries afterward.

Magnetic Qualities of Oxygen. Fleming and Dewar. Lond. *Elec.*, Nov. 27.—A short note stating that their recent researches, as shown in a recent Royal Society paper, remove liquid oxygen definitely from the ranks of magnetic bodies, the word magnetic being used in the commercial sense; Hadfield's so-called non-magnetic steel has an average permeability of 1.3 compared with which that of liquid oxygen is immensely less; but the susceptibility of oxygen greatly exceeds that found by Curie for a saturated aqueous solution of ferric chloride.

Effect of Röntgen Rays on the Skin. Fuchs. *West. Elec.*, Dec. 12.—A note stating that out of 1400 cases under his supervision there have been but four instances of slow-healing burns; to prevent this he suggests to shorten the exposure to a minimum, to place the tube not nearer than 12 inches from the body and to rub vaseline well into the skin, leaving a coating on the body to be exposed; also to use glass plates to protect those parts of the body which are not to be exposed. Exposures of the hand, foot, arm and neck may be cut down to 10 or 30 seconds for locating bullets; for showing details in arm, knee and head, from one-half to two minutes, and for shoulder or trunk from three to 10 minutes; anything longer than 10 minutes is unnecessary and is likely to produce sunburns; these burns are not more dangerous than ordinary burns; the action he believes is caused by the ozone.

Röntgen Phenomena; Theory and Practice. Willyoung. *Proc. Eng. Club, Phila.*, November.—An article giving a summary of the subject. He has a decided preference for the induction coil as distinguished from the Tesla apparatus; in conclusion he describes and illustrates a rotary brake for induction coils enabling the 110-volt lighting currents to be used directly with induction coils; the make-and-break consists of a brass contact wheel with pieces of slate inserted on its periphery, the wheel being run in distilled water by means of a small electric motor of 0.08 horsepower.

X-Ray Meter. Kolle. *Elec. Eng.*, Dec. 9.—A brief, illustrated description of an apparatus consisting of a frame like that of a slate, in which are held eight parallel strips of sheet aluminum ranging from 1 to 12 mm in thickness, and arranged in regular order, each one being plugged with lead wires, the thinnest one having one plug, the next two, and so on up to eight; this is held in front of the fluorescent screen, and as the power of the tube increases one section after another becomes less transparent; the lead plugs show as dark spots and enable the number of the strip to be read off on the fluoroscope.

Sympsychograph. Jordan. *Pop. Sc. Mo.*, December. A communication regarding his article under this title, which was referred to in the *Digest*, Oct. 3. He states that he "had not the slightest idea that any one capable of reading bound books would be deceived by the meaningless phrases in that bit of burlesque. I intended it as a piece of gentle satire on the 'Wizards' and 'Impressionists' who follow in the wake of scientific work which attracts attention, and which pour their vagaries into the long ears of the daily newspaper."

Effect of Removing the Ends of a Magnet. Smith. *West. Elec.*, Dec. 5.—A description of an experiment in which a small piece was cut off transversely from the end of a magnetized steel bar magnet, which it appears was previously carefully annealed; when the length of this small piece was great as compared with its width (its length being the width of the magnet) it was found to be a complete bar magnet with a south pole at one end and a north pole at the other, the axis of it being therefore transverse to that of the original magnet; this was the case when the saw cut was made from one side only; when the cut was made from both sides towards the centre the piece had a consequent pole in the middle.

Elements of Complex Quantities and Vectors. Dommerque. *Elec. Eng'ing.* December.—A short article showing their use in alternating current work.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Sodium and Potassium Chlorides. Lunge. Lond. *Elec.*, Nov. 27.—An abstract of the articles noticed in the *Digest*, Nov. 21. In an editorial introduction it is stated that in England this industry has hardly begun; one factory operating the Richardson and Holland process has been in operation for over a year, but there have been so many break-downs that but little of the product has been put on the market; the Castner and Kellner process is to be started during the coming year.

Continuous Process of Zinc Plating Wire. Cowper-Coles process. *L'Eclairage Elec.*, Nov. 14.—A brief, illustrated description of the apparatus, including some of the details.

Electrolizers for Laboratories. Fuchs. *Zeit. f. Electrochemie*, Nov. 20.—A brief, illustrated description of three different forms of laboratory apparatus for chemists, intended for electrolytic researches, more especially for flowing liquids.

McDonald Battery. Lond. *Elec.*, Nov. 27.—A brief, illustrated description of this primary battery with unfavorable criticisms; it was described in the *Digest* last week; the unfounded claims of the manufacturers are criticised; it is claimed that only 2.5 ounces of zinc are consumed for each 100 watt hours. The article in the Lond. *Elec. Rev.* is concluded in the issue of Nov. 27, the results of the tests made by various parties in favor of the battery being criticised very unfavorably.

Electrolytic Extraction of Gold from Cyanides. Pfleger. *L'Eclairage Elec.*, Nov. 14.—A brief, illustrated description of his tanks.

Progress in Electrochemistry During 1895. *L'Elec.*, Nov. 28.—An abstract of the article noticed in the *Digest*, Nov. 14.

Porous Carbon Cylinders. Loeb. *Elek. Zeit.*, Nov. 19.—An abstract of the article noticed in the *Digest*, Nov. 28.

Bleaching. R. K. *Electrochem. Zeit.*, November.—An article on the practical results obtained with electrolytically prepared chloride of calcium for cotton and linen. This material is now beginning to be introduced in practice in the large bleaching establishments, where it is supplanting the older methods; he has used it exclusively for some time for both cotton and linen, and is very well satisfied with it; the material has a purer white color than with the ordinary chloride of calcium, and the consistency is more easily retained; to obtain the same whiteness with the old method it was necessary to boil in acids and bleach twice, which was both expensive and destructive to the fibres; he does not consider it necessary to install an expensive plant for electric bleaching as the same results can be obtained from the electrolytically prepared chloride of calcium; the bleaching with this material is cheaper than by the older processes, even though the cost of the material is somewhat greater; the material is about 15 to 18 per cent. more effective; the practical application of this material is the same as with the ordinary chloride of calcium, except that it is not necessary to repeat the process to obtain a pure white; he gives the results of some comparative tests.

Improvements in Electrodes. Weyer. *Electrochem. Zeit.*, November.—An article giving what appears to be a good summary of the progress in electrodes made during the past year (some of the improvements, however, are somewhat older). He begins with the subject of batteries and enumerates the improvements, giving brief descriptions; he then discusses the electrodes in the electrolysis of chlorides.

Purifying Cadmium. Mylius and Fromm. *Zeit. f. Electrochemie*, Nov. 20; abstracted from *Zeit. f. Anorg. Chem.*, 13, p. 157.—They use cadmium sulphate, an anode of the crude cadmium and a cathode of platinum or cadmium; the current density is 0.5 to 1 ampere per square decimetre of anode; the lead remaining on the anode must be brushed off occasionally; the solution should be kept slightly acid to prevent the formation of spongy metal, and it should be kept continually stirred; the cadmium deposit is easily removed from the cathode; the resulting cadmium contained probably no more than a tenth of a per cent. of metallic impurities.

Chromium. *Elec. f. Electrochemie*, Nov. 20.—A note stating that in a recent paper it is suggested to cover chromium electrolytically with a coating of the metal with which it is to be subsequently alloyed, in order to protect it from oxidation.

Separating Metals by Means of Soluble Anodes. Pauli. *Elect. och. m. Zeit.*, November.—A brief article discussing the subject of separating various metals from their solutions by direct deposition without the use of externally applied currents; he gives a list of those metals which can be separated in this way, among which are iron, zinc, lead, copper, antimony and mercury.

Zinc Analysis. Stortenbecker. *Zeit. f. Electrochemie*, Nov. 20.—In order not to have to copper plate the platinum vessel in the usual method

of the electrolytic determination of zinc, he uses a vessel of silver ; the zinc deposits well from the double oxalate of zinc and potassium ; it may be removed by boiling it in dilute hydrochloric acid.

Preparing Articles for Plating. TRYCHELUS. *Zeit. f. Electrochemie* Nov. 20.—A brief abstract from his recent patent. It applies chiefly to articles made with the softer metals; he uses a sand blast with which is mixed the desired pickling liquid, which depends on the material, and is the same as that usually used, namely, nitric acid for zinc, copper and silver; aqua regia for steel, gold and platinum; hydrochloric acid for aluminum, iron, ivory and marble; caustic potash for wood, fluoric acid for glass, etc.

Chlorine and Alkalies. Zeit. f. Electrochemie, Nov. 20.—A brief illustrated description of the SINDING-LARSEN system for the electrolysis of salt with mercury cathodes.

Cyanide Process for Extracting Gold. Elec. Jour., Dec. 1.—A description of the plant at Chapaca, Wash., which has just been completed and is said to be the first plant of its kind in this country to wholly abandon the zinc method and adopt the Siemens & Halske electrical method ; it is a 50-ton plant. The original solution contains $\frac{3}{100}$ of 1 per cent. of cyanide of potassium dissolved in water, to which the ore is subjected for about 48 hours, which extracts about one third of the gold; the ore is then treated for about 48 hours with a stronger solution containing $\frac{6}{100}$ to $\frac{8}{100}$ of 1 per cent. of the cyanide ; after this the ore is washed with water; 96 per cent. of the gold is extracted. The anodes are made of iron plates, which are so placed in the tank that the solution has to pass successively between the plates ; the cathodes are of sheet lead ; the remaining solution still contains 1 per cent. of the gold which it had, and is used over again after being strengthened with additional cyanide. The best results are obtained with six volts and a density of 0.06 to 0.065 ampere per square foot of lead surface, counting both sides; it then requires about eight hours to pass 50 tons of the solution through the two tanks. With this method there is great saving in the chemicals, as the electricity will deposit the gold from very weak solutions, and do it quite thoroughly ; with these weak solutions very little of the base metals are taken into solution; after about thirty days sufficient gold is deposited to melt up the anodes and separate out the gold from the lead. The method is particularly applicable to low grade ores; the cost of treatment is $1.67 per ton, using cottonwood fuel at $3.50 per cord; 92 per cent. of the gold is saved as compared with 80 with the zinc process and the cost of treatment is 20 per cent. less.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Magneto-metric Measurements Free from the Earth's Magnetism. WEBER. *Elek. Zeit.*, Nov. 26.—A reprint of a recent paper in which he makes a number of suggestions for eliminating the effects of external magnetic influences such as those caused by railway currents, while making magneto-metric measurements. Dubois recently suggested such a method which is here described briefly together with suggestions for modifications. Instead of using a single magnetic needle Dubois uses an astatic system, the lower needle of which is about over the middle of the magnet to be examined and is therefore equally affected by the two poles, while the upper needle will be then deflected by the magnet; the whole system will therefore be deflected, although it is independent of the earth's magnetism and any variations in it. The present writer suggests a number of modifications; for instance, the needles forming the astatic system may be suspended parallel to each other in a horizontal plane, the magnet being also in that same plane ; the action will then be a differential one; in such a system the needles may be perpendicular or parallel to the magnet; they may also be suspended so that both needles are vertical, the magnet being directly beneath the axis of suspension or it may be parallel to them with its middle point to one side of the middle point of the needles, the magnet being equally distant from the two needles. Such measurements are for comparative as distinguished from absolute determinations, but the accuracy cannot be as great as that obtained by the usual methods; the results will depend on the length of the needles or the distance between them, but these distances are small and not capable of accurate measurement ; he has deduced formulas for these arrangements, but they are not given in the paper; these formulas are simplified when the bar magnets used are all of the same length and if instead of observing deflections, these deflections are compensated by an electric current whose magnetic effects can be calculated. In the discussion Kohlrausch questions whether this method will be more accurate than those by the usual method even when there are external magnetic influences; he thinks it will not be easy to use the method in practice but he believes it capable of being developed.

Platinum Thermometer with Potentiometer. FISHER. Lond. *Elec.*, Nov. 27; the conclusion of his series of articles on the potentiometer (*Digest*, July 18).—In the present one he discusses the use of the platinum thermometer in connection with the potentiometer; he first gives an illustrated description of the brilliant work done by Callender and Griffiths in perfecting the platinum thermometer in which the alteration in the electrical resistance of platinum is used to measure the difference of temperature up to 1500 degrees C., and down to the lowest possible temperature, with an accuracy throughout the whole range hitherto unheard of; the temperature coefficient varies slightly with every batch of wire, but when once ascertained it rarely if ever alters in the least, even if the wire is heated almost to the fusing point; an illustrated description of the original Siemens instrument is also given. In the Callender-Griffiths instrument the wire has a diameter of 5 to 8 mils and is wound non-inductively on a framework of mica, the tube also containing a compensating wire of platinum of the same size and of equal length, which being run quite close to the leads in the tube compensates the varying and unknown quantity due to the temperature of these leads; the disturbing influences in both are equal, and as they are on opposite sides of the equipotential point they neutralize each other; the coefficient of the platinum is taken as 0.37 per cent. per degree. The final instrument described is a modification of this in connection with the potentiometer, the apparatus being direct reading; it has a number of advantages as the compensation, resistance of leads, thermo-junctions, connections, etc., need not be considered while there is no limit to the distance between the thermometer and the measuring apparatus, which may even be measured in miles; he uses a much thicker platinum wire, which is sufficiently stiff to maintain its form; while not quite as accurate it is well within the limit required by engineers for measuring the temperature of the gases in flues which can be done with certainty within 1 or 2 per cent. Another form of instrument contains a dial on which one inch corresponds to 100 degrees, and it can therefore be read directly by the stoker; it can also be used as a recording instrument, being kept in the office of the station.

Registering Magnetic Elements. ESCHENHAUGEN. *Proc. Lond. Phys. Soc.*, November; abstracted briefly from the *Berl. Ber.* 39, page 965.—In a horizontal magnetometer he used a steel mirror suspended by a quartz fibre, which was twisted so that the magnetic axis of the mirror was at right angles to the magnetic meridian; he thus succeeded in registering by means of photographic apparatus a succession of small changes in the value of $\mathfrak{H}$, which, with the large magnets usually employed, are entirely masked.

Measurement of Very Large and Very Small Alternating Currents. CAMPBELL. *Proc. Lond. Phys. Soc.*, November.—A reprint in full of the paper abstracted in the *Digest*, July 11.

Specific Heat Determinations. SCHLAMP. *Proc. Lond. Phys. Soc.*, November; abstracted briefly in the *Wied. Ann.*, 58, page 759.—He determined the specific heats of some organic substances by introducing them into a calorimeter traversed by a wire which conveyed the same current through a similar calorimeter containing the liquid used as a standard.

Variations in the E. M. F. of Clarke Cells with Temperature. AYRTON and COOPER. Lond. *Elec. Rev.*, Nov. 27.—An abstract of some length of the paper noticed in the *Digest*, Oct. 17.

Bare Wire for Resistance Coils. BURSTALL. *Proc. Lond. Phys. Soc.*, November.—A reprint of the complete paper abstracted in the *Digest*, Oct. 3.

Portable Galvanometer. TOBLER. *Jour. Telegraphique*, Nov. 25.—An illustrated description of a convenient portable d'Arsonval galvanometer, the whole of which is contained in a box through one side of which is a telescope containing the scale, the illumination being obtained from a small lamp; it is stated by the author to be sufficiently sensitive to measure the currents used in practice and the insulation resistance of cables; with 20 good Leclanche cells the constant is 220 megohms.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Simultaneous Telephony and Telegraphy. CAILHO system. *Jour. Telegraphique*, Nov. 25.—An illustrated description by Tobler, of this system, which he considers one of the best solutions of the problem. The principle of this is to use the metallic loop for the telephonic transmission, while these two wires are used in multiple as a telegraph line with the earth as a return. The line wires are attached to the primary coil of a transformer, the secondary of which is connected with the telephone; the middle point of the primary is connected to the telegraph instrument; the telegraphing currents therefore divide into two equal parts, which pass in opposite directions through the two halves of the primary to line, and therefore do not affect the telephone, while the telephone current passes through the whole of the primary and operates the telephone, but does not affect the telegraph apparatus; the transformer is wound with two identical coils. The extra current generated when the telegraph circuit was broken at first gave trouble as it was heard in the telephone; to avoid this a condenser is placed in parallel with the telegraph apparatus, as this prevents the suddenness of the breaking of the current; this is necessary only with coils of considerable resistance as compared with their self-induction. In the later forms the two coils are wound on the two halves of the same iron core; some measurements of such a set of coils are given. The author experimented with this system on the underground cable through the Gothard tunnel, the length of which is about 10 miles, and obtained excellent results; this system is used quite extensively in France, as also on the two circuits from Paris to London.

Telephone Statistics for 1894. Elek. Zeit., Nov. 26.—An abstract in the form of a table of the statistics recently published in the *Jour. Telegraphique.* The same issue contains an editorial article stating that as the above official statistics are quite incomplete, another table has been prepared by the editors in which the omissions are supplied, the data being obtained from other sources. The countries are limited to those of Europe and are given in the order of the relation between the population and the number of telephone subscribers; Sweden heads the list,

followed by Switzerland, Luxemburg, Norway, Denmark, Finland, Germany, England, Netherlands, Belgium, France, etc. In another column is given the relation between the population and the number of networks (presumably meaning the number of groups of subscribers connected with the same station), this being taken as an indication of the extension over those countries; in this Luxemburg heads the list followed by Finland, Switzerland, Sweden, etc. Another column gives the average charges and from this the conclusion is drawn that the charge should be regulated by the size of the network if the intention is to extend the service as much as possible.

Automatic Central Telephone Calls. West. *Elek. Zeit.*, Nov. 26.—In a recent description (see The Electrical World, Aug. 22, p. 217) an apparatus of this nature was mentioned; in the present article an improved form is described.

Competing Telephone Exchanges. De Land. *Elec. Eng'ing*, December.—A short article showing that while at first competing exchanges are profitable, yet the records show that often with the most favorable prospects one after the other suspends operation, the cause being inability to secure an income from the low rates which would warrant the expenditure necessary to secure the requisite talent for prompt and efficient service; the question of low charges plays a secondary part in the problem of supplying satisfactory service, the quality and the rapidity of the service being essential factors; telephone rates are reasonable when proper allowances are made for the maintenance and operation of the plants. A list of 24 towns or cities is given in which the competing exchanges have failed.

Simultaneous Telegraphy and Telephony. Cailho system. *Elec. Eng.*, Dec. 2.—A translation in part, with the illustrations, of the article abstracted above.

Basis of Telephone Charges. De Land. *Elec. Eng'ing*, December.—A short article showing how very fast the number of possible conversations, and therefore the investment, increases with the number of subscribers.

Telephone Trunk Line System in Great Britain. Gavey. *Elec. Eng.*, Dec. 9.—The beginning of an abstract of the paper noticed in the *Digest*, Dec. 5 and 12.

European Telephone Statistics for 1894. Dommerque. *Elec. Eng'ing*, December.—A table compiled from the data in a recent number of the *Jour. Telegraphique*.

MISCELLANEOUS.

Production of Pulverized Metal. Zeit. f. Electrochemie, Nov. 20.—A brief description of a method in which the molten metal is run in the form of a fine stream through a powerful electric arc; the high temperature to which it is thereby raised is said to sub-divide the material.

Ozone and Bacteria. Andreoli. *L'Eclairage Elec.*, Nov. 21.—A long article, including numerous tables of results, being a summary of a recent article by Ohlmueller in the publications of the German Hygienic Commission. The results of a series of systematic experiments are given. The conclusions appear to be that under certain conditions ozone is a germicide, and under others it is less so or not at all; ozone acts in a very powerful and destructive way on bacteria in suspension in water, provided the water is not too much contaminated with organic material. The present writer believes that the importance of these conclusions should not be exaggerated as they were obtained from laboratory experiments, which are not always applicable in practice; he claims that it is not impossible to ozonize water or to sterilize it, but the problem is accompanied with almost insurmountable difficulties; there is a way of passing ozone through the water so that it is absorbed in part, and there is another way in which it will not be absorbed at all, but the methods are not described.

Balata Industry in Dutch Guiana. Lond. *Elec. Rev.*, Nov. 27.—A reprint of a consular report from the *Jour. Soc. Arts*. It is used as a superior form of gutta percha and passes under that name; it is somewhat softer at the ordinary temperature and not as rigid in the cold; its most marked difference is that it is only slowly acted upon by the atmosphere.

Geneva Exhibition. Ritter. *L'Ind. Elec.*, Nov. 25.—A continuation of a description of the exhibits. It includes an illustrated description of an Alioth rotary transformer and brief descriptions of some of the accumulator exhibits. Another series of descriptive articles by Montpellier is begun in *L'Elec.*, Nov. 28; several continuous-current dynamos are illustrated and described.

Electrically Controlled Torpedo. Haskins' system. *West. Elec.*, Dec. 5.—A brief description of a system in which an automatic starting device on the torpedo is put into action when it comes under the influence of the attractive force of the iron hull of a vessel; the mechanism controls a motor which operates the rudder, steering the torpedo under the direction of the stronger attraction and reversing it when it passes that line; the zone of attraction is said to be about 300 feet in diameter; the magnetic force is not in action until the torpedo is out of the way of the vessel from which it is run; the starting device weighs about 125 pounds and can be applied to any torpedo; it has been tried in Boston harbor on five occasions and worked in a satisfactory manner.

Electromagnetic Coast Defence. West. Elec., Dec. 5.—An illustrated description of the Badt system for exploding submarine mines. An open magnetic circuit magnet is traversed by an alternating current from the shore; when an iron vessel approaches it the magnetic circuit is partially closed, which diminishes the current, this being indicated by an instrument on the shore; when the current has been reduced to a certain amount the submarine mine is exploded by another current.

Electrical Speed Indicator. Amer. Mach., Dec. 10.—An illustrated description of a device consisting of a small magneto-generator, the voltage of which is taken to be proportional to the speed and is indicated on a sort of voltmeter, which latter may be placed some distance off.

Electricity in Naval Life. Fiske. *Elec. Eng.*, Dec. 2; a continuation of the reprint.—He describes his Azimuth telegraphs; two transmitters and two receivers are used on separate circuits, one graduated in degrees and the other in minutes; angles as high as 20 degrees can be telegraphed with great quickness and extreme accuracy, the errors being much less than one minute; the circuits are always closed; the same system can be used for telegraphing orders to parts of the ship; the system has been adopted by the United States Navy, and is about to be tried on the *Brooklyn*; the principle of the instrument is the measurement of a resistance in the form of a Wheatstone bridge; detailed illustrated descriptions are given. The issue of Dec. 9 contains an illustrated description of the electric telescope sight which is used in directing guns.

Electrical Publications as Holiday Presents.

A Christmas or New Year gift does not need to be expensive, but it should combine attractiveness with utility.

For those in the electrical business no other holiday present for one's self or friend could be more appropriate than one of the following:

The Electrical World for 1897, costing but $3, which includes postage to any address in the United States, Canada or Mexico, and which gives the recipient 52 different dividends during the year.

Houston and Kennelly's Electro-Technical Series, 10 volumes, in a substantial muslin-covered box, forwarded prepaid to any address for $10, or whatever number of the individual volumes may be desired at $1 each. The titles of the different books comprising the series are as follows, and detailed descriptions will be found elsewhere in this week's issue:

Magnetism.	Electric Arc Lighting.
Electric Heating.	Electric Street Railways.
Electric Telegraphy.	Alternating Electric Currents.
The Electric Motor.	Electric Incandescent Lighting.
The Electric Telephone.	Electricity in Electro-Therapeutics.

Houston's Dictionary of Electrical Words, Terms and Phrases, price $5.00, is the standard work of its kind, and makes an excellent Christmas present. The list contains many others to choose from.

New Books.

Electric Street Railways. By Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc. D. Elementary Electro-Technical Series. New York: The W. J. Johnson Company; 367 pages, 158 illustrations. Price $1.00.

This little volume is intended to meet the needs of those who wish definite knowledge of the main principles involved in electric traction. It is to the large and increasing number of intelligent readers, comprising many connected in some way with electric railway enterprises, who have generally a dim and frequently an inaccurate idea of the methods employed to produce the familiar results of the electric railway, that the authors address themselves in this very interesting work.

The 16 chapters comprise an introduction, a sketch of the early history of the electric railway, a brief statement of the elementary principles of electricity, descriptions of the parts of an electric railway system, and a chapter to each of the subjects of storage-battery traction and electric locomotives. There are in addition, chapters on electrolysis of water and gas pipes, and a brief statement of the financial conditions of equipment, operation and maintenance.

The style and appearance of the book are both attractive. The authors possess an extreme lucidity and clearness of style, and an ability to present difficult subjects in plain and simple language, which has been most advantageously employed in this case. There is hardly any class of readers who could fail to be interested in this delightfully simple and interesting explanation of the apparent mysteries of the electric railway, and certainly few who would fail to understand the subject after so clear an exposition.

In most books attempting to popularize electrical subjects the authors have usually avoided the Scylla of technicalities to come to grief in the Charybdis of wearisome explanations of a too elementary kind. Messrs. Houston and Kennelly have written this little work, however, to be read by intelligent people, and there is no doubt that it will become popular. It is a book that can be safely recommended by a practicing electrician to his non-technical friends.

The authors have given the salient points of their subject only, while the numerous illustrations, which are for the most part reproductions of photographs of actual machines, add greatly to the interest and value of the book.

The chapter which treats of the elementary principles of electricity is most felicitous. The apt illustrations, the lucid language and the simple definitions and statements make this most valuable to the non-technical reader. The necessary definitions and explanations of the electrical units

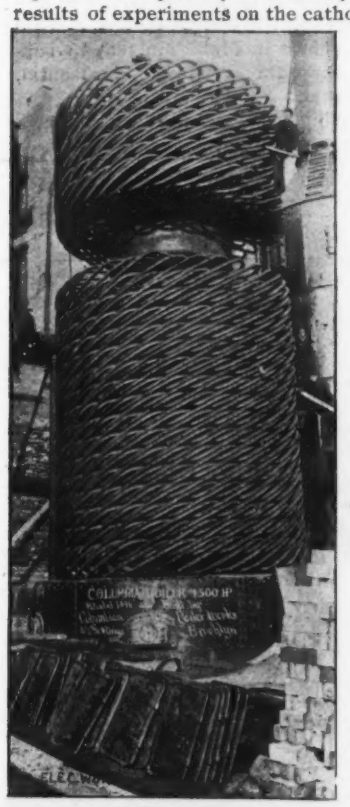
are so logically and clearly given that they will relieve this part of the subject from much of the terror with which it is regarded by the laity.

In the chapter on electric locomotives there is a timely and intelligent discussion of the part to be taken by electricity in the future of trunk-line railroading.

MISCELLANEOUS PAPERS. By Heinrich Hertz. Introduction by Philipp Lenard. Translated by D. E. Jones and G. A. Schott. Published by Macmillan & Co., London. The Macmillan Company, New York; 340 pages. Price, $3.25.

This work in the German forms the first volume of Hertz's collected works, the second being that on the Propagation of Electrical Waves, translated by Mr. Jones, and the third on the Principles of Mechanics. This volume, including as it does an insight into the early life of Hertz, is of special interest in showing how his career was shaped, his early inclinations and the results of his early researches. Nearly all of the papers contained in this volume have been published in different periodicals more or less inaccessible, especially to the American reader, so that in the form now presented they show in a consecutive manner how Hertz systematically carried out his researches and his remarkable ability for interpreting the ideas of Maxwell and carrying these ideas to a successful issue experimentally. We also see how the seed was sown in his discovery of the property possessed by cathode rays of passing through metals, for the recent discovery of Röntgen. The first paper is on "Experiments to Determine the Upper Limit to the Kinetic Energy of an Electric Current," and for which Hertz took the prize offered by the Philosophical Faculty in the University of Berlin in 1878. This was his first investigation and so well pleased was Helmholtz with the manner in which it was performed that the latter suggested that Hertz take up the study of a prize problem in electromagnetics propounded by the Berlin Academy. Hertz, however, refrained and took up instead the investigation on "Induction in Rotating Spheres" which forms the second paper in the volume. This subject Hertz treated in a very complete manner and the paper was submitted as his inaugural dissertation for his Doctor's degree, and for which he received the highest commendation from the Berlin Philosophical Faculty. The third paper is on the "Distribution of Electricity Over the Surface of Moving Conductors," and the fourth again takes up the treatment of the subject of his first paper. The fifth is on the "Contact of Elastic Solids," being a successful study of the changes of form which take place at the point of contact of two pieces of glass in the production of Newton's rings. The subject of hardness was here introduced and it was to Hertz that the first clear treatment of this question is due. He defines hardness as the strength of the body relative to the kind of deformation which corresponds to contact with a circular surface of pressure. The eighth paper treats of the evaporation of liquids and especially of mercury in vacuo. The thirteenth gives the results of experiments on the cathode discharge, while the seventeenth is "On the Relations Between Maxwell's Fundamental Electromagnetic Equations and the Fundamental Equations of the Opposing Electromagnetics."

Naturally this volume does not possess as much interest as that containing the collection of papers on "Electric Waves," but it is still of considerable value to all interested in scientific research.



THE COLUMBIA BOILER.

The Columbia Boiler.

A close inspection of the accompanying illustration will show important modifications of existing types of boilers which conduce so strongly to improvement in the working qualities of the Columbia boilers as to be worthy of special description.

The boiler is manufactured by the Columbia Steam Boiler Works of 187-193 North Eighth Street, Brooklyn, N. Y., of which Mr. Thos. J. Lawler is general manager. It consists of a cylindrical shell which is placed in a vertical position and the curved surface of which is perforated with holes at regular intervals. In these holes are fitted U-shaped symmetrical tubes, which can be changed end for end without difficulty. The ends of the tubes are forced through the holes and beaded on the inside, thus forming a steam-tight joint. Owing to their shape there can be no unequal expansion and contraction of the tubes which might cause them to leak at the joints or to fracture where they are bent.

In former boilers of this type the tubular construction has been carried from the top of the shell to the bottom without interruption, a method which results in the accumulation of refuse on the water line of the tubes causing them to burn out. Moreover, the steam has difficulty in separating from the water in such confined limits. This objection is obviated by the steam liberator, which is an important feature of the Columbia boiler. This device is merely an enlarged chamber on either side of the water level and surrounding the cylindrical shell. The water line is contained entirely within this steam liberator which is provided with manholes to permit the easy removal of any troublesome deposits. Above the steam liberator is the steam space with tubes similar to those used in the water space and sufficient heated surface is provided to give an extremely dry and even a slightly superheated steam. The boiler has an outer casing and can be fired from all sides. There are no baffle plates or diaphragm to produce an artificial circulation. The water surface is extremely large, thus avoiding rapid fluctuations in the water level and securing a ready liberation of the steam. The volume of water carried is sufficient to maintain a good staying pressure, and nothing but gross carelessness in firing or feeding can bring about low water or a great variation in pressure. There are no bolted joints or diaphragm plates. The bottom of the boiler is of such shape that every drop of water can be drained therefrom by a special cock provided for that purpose. The steam outlet is far above the water level and it would be almost impossible for water to be carried over with the steam, even if the boiler were pumped up considerably above the upper gauge cock. The steam room is very large, possessing all the good properties of a steam dome, coupled with perfect mechanical construction.

Although it has been on the market but a comparatively short time, the excellent qualities of the Columbia boiler have been widely recognized and favorably commented upon by many experts in boiler construction.

The accompanying illustration shows a Columbia boiler of 1000 horse-power now in course of erection for the New York Steam Company at the foot of East Sixtieth Street, New York City.

Marine Arc Lamp.

The General Electric Company's long-burning arc lamp has been adapted for ship use, both for the hold and on the deck. This marine arc lamp is somewhat shorter than the standard long-burning arc lamp, which has met with much success, and is constructed to burn 50 hours without changing the carbons. The economy in carbons the use of this lamp induces is said to be considerable, and this is added to in the saving effected in the labor of the trimmer. The outer globe of the marine lamp is of clear glass and is cylindrical in shape instead of spherical. It is protected by a heavy wire guard against injury from outside. A large number of these lamps is already in use both on the Atlantic and Pacific seaboards as well as on the Lakes.

MARINE ARC LAMP.

Steam Trap.

A new form of steam trap known as the Geipel, is being placed on the American market by Messrs. Thorpe, Platt & Co., 97 Cedar Street, New York City.

Referring to the sectional view herewith, the expansion parts are arranged in the form of an isosceles triangle, causing a considerable

STEAM TRAP.

motion to be imparted to the apex for very small changes in the length of these parts; there is also a certain amount of elasticity in the pipes. The lower pipe is brass and is connected to the steam pipe while the upper

iron pipe forms the discharge. These pipes form two sides of a triangle, the valve seat *D* being at the apex. The valve spindle *C* butts against the lever.

When the brass pipe is contracted by low temperature the apex *D* is drawn down, the valve opens and the water is discharged. When steam enters, the brass tube is caused to expand, raising the apex, thus closing the valve. By means of the screw adjustment *A* the valve may be set to blow off at any desired pressure. The valve may also be opened by hand by merely pressing the lever, and it may be readily examined by unscrewing the cover *B* of the valve-box without removing the lever.

Steam traps designed upon the thermostatic principle, in which the difference between the heat of the steam and the heat of the water actuates a valve to discharge the collected water, are not new ; but the difficulty with most traps of this class has been that the motion set up by the contracting and expanding elements has been too small, or the arrangements for adapting the trap for use with steam at various pressures have not been satisfactory. It is claimed that these difficulties are overcome in the Geipel trap and that it will work equally well with one-half or 300 pounds of steam.

This trap is manufactured in five sizes, has no floats and no faced joints, and, it is said, will discharge a continuous stream of water the full bore of the pipe connections ; it is simple and compact and is suitable for mounting on the wall of a boiler room or on the bedplate of an engine.

Wetherill Corliss Engines.

The admitted superiority of Corliss engines with regard to steam distribution and economy is now so general that it needs but passing reference. The Corliss engine, however, offers a large field for ingenious de-

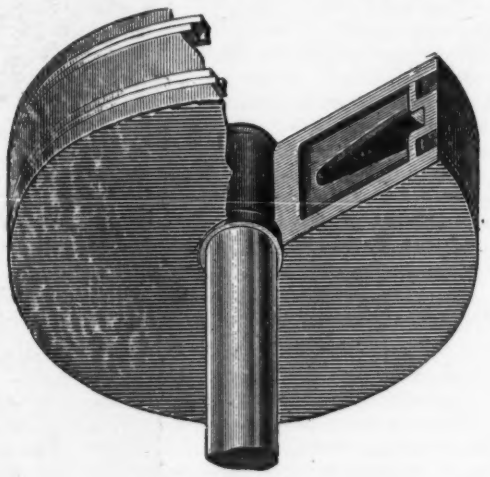


Fig. 1.

sign and improvement, and in this respect the Wetherill Corliss engine built by Robert Wetherill & Co., Chester, Pa., is noteworthy.

This engine is built of the best of material, the shafts and connecting-rod being of hammered wrought iron. The frame and cylinder are of cast iron, and particular care is used in the manufacture of the latter to ensure its being of close-grained, homogeneous metal with excellent wear-

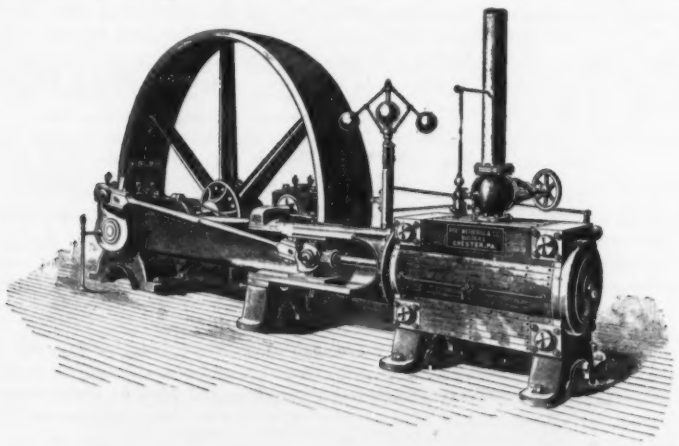


Fig. 2.

ing qualities. Appreciating the necessity of having the full boiler pressure at the beginning of the stroke and also the evil effects of a strangled exhaust, the parts have been made liberal, and the valve gear is such as to almost instantly open and close them at the proper time. The valve gear is constructed with great care, and ample means are provided for taking up wear and for setting the valves. The trip plates are of hardened steel, and as they are simple rectangular pieces they are reversible and have four wearing edges which can be successively brought into play as needed. The dash pots are so constructed as to require no packing whatever, and the amount of

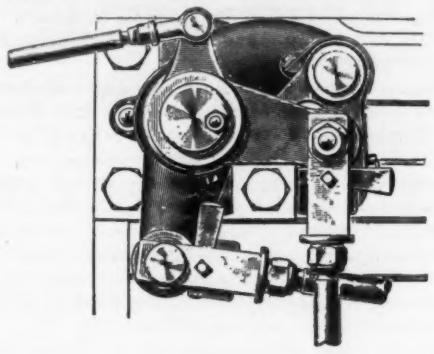


Fig. 3.

cushioning is regulated by a valve in the usual way. The motion is exceedingly prompt, silent and effective.

The piston is a special feature of the engine, and is shown in Fig. 1. Its ribbed construction makes it extremely tight, an important matter in large low-pressure pistons. The packing rings, instead of being held out by steam pressure or by their own elasticity, are in sections, each of which is held out by a German silver spring. This spring is non-corrosive and does not lose its tension at high temperature. This provision is a most effective one, and it is said that the engine can be run single-acting with the cylinder head off without the least sign of leakage.

The frame of the engine is said to be very stiff and strong, and equally rigid, whether the engine is running over or under.

A very substantial cross-head is used. It is made in two distinct types. The larger cross-heads adjust the wear by screws and check-nuts, while in the smaller ones wedges are adapted for the same purpose. The slippers are faced with a specially prepared babbitt metal. The crank-pin bearing is of the split-box and strap type and is adjusted by wedges. The bearing itself is of a fine quality of bronze and has large wearing surfaces. The main bearing is arranged in quarters, and ingeniously arranged to take up wear. The anti-friction metal used in these bearings is specially prepared for this purpose.

The governor is belt-driven and is of the pendulum type. It is what is known as a loaded governor and operates without dash-pots, and it is perfectly dead beat in its action. This engine is constructed in vertical and horizontal types, the latter being shown in Fig. 2, and may be supplied in tandem or cross-compound units either vertical or horizontal. Sizes are listed from 36 to 1600 horse-power.

Fig. 3 gives a detail view of the releasing gear, and in Fig. 4 is shown

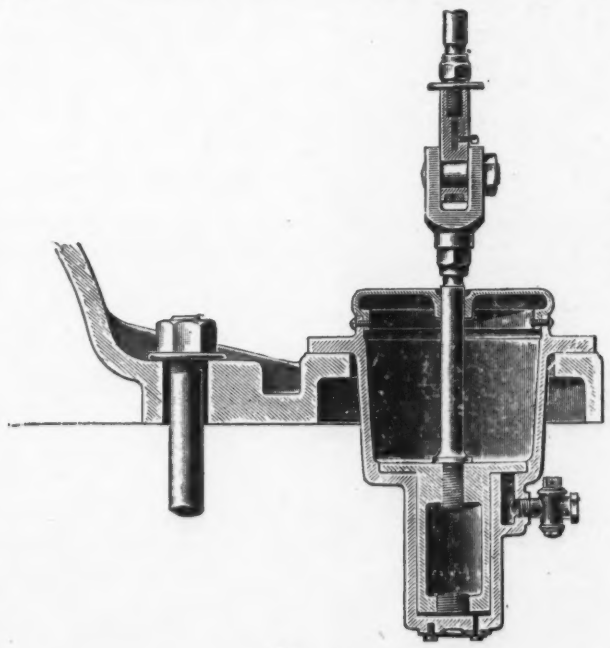


Fig. 4.

the vacuum pot which avoids the inertia of the old style weight dash-pot. The vacuum pots are mounted on a projection cast on the side of the cylinder or on the cylinder feet, and are within easy reach of the engineer.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Dec. 12, 1896.

ELECTRICAL STOCKS show little activity, prices generally being a shade lower than last week. General dulness seems to prevail.

TELEGRAPHS AND TELEPHONES.—Bell telephone closed with a net gain of ¼ over last week's prices and New England Telephone advanced one point. The telegraph list remains practically unchanged.

TRACTIONS.—The demand for street railway securities continues light, although earnings in general are increasing. Columbus Street Railway was the most active stock in the list. Few changes are recorded, the advances being in Buffalo Railway, West End common and preferred, and Worcester common.

DIVIDENDS.—The Western Union Telegraph Company has declared a quarterly dividend of 1¼ per cent., payable January 15, 1897.

THE EDISON ELECTRIC ILLUMINATING COMPANY, Boston, Mass., has voted to increase its capital stock $500,000. This will bring the figure up to $3,920,000.

RAILWAY EARNINGS.—The Scranton Traction Company reports gross earnings for November of $31,301, an increase of $3516 as compared with the same month last year, and net earnings of $14,528, an increase of $1607 The Columbus Street Railway Company reports gross earnings for November of $48,077, a decrease of $1651, as compared with the same month of last year, and net earnings of $24,293, an increase of $2,651.

A ST. LOUIS AND CHICAGO COMBINE.—Chicago capitalists have taken stock in the St. Louis Electric Light & Power Company. The capital is increased from $2 00,000 to $700,000, and the company will be reorganized and name changed to the St. Louis Electric Light, Heat & Power Company, and a site has been selected for a duplicate electric plant. The deal is practically a combination of the local company with the Western Electric Company of Chicago.

ELECTRICAL STOCKS.	Par.	Bid.	Asked.
Chicago Edison Company	100	..	
Edison Electric Ill., New York	100	100	101½
" " " Brooklyn	100	88	93
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	28	28½
Electric Storage, pref	100	29¾	30¼
General Electric	100	32	32⅛
General Electric, pref	100	70	..
Westinghouse Consolidated, com	50	25	..
" " pref	50	50½	..
BONDS.			
Edison Electric Ill., New York	105	106½	..
Edison Electric Light of Europe	100	75	8<
General Electric Co., deb. 5s	100	92½	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	209¾	209½
American District Telegraph	100	*20	39
American Telegraph & Cable	100	90	91½
Central & South American Telegraph	100	124	127
Commercial Cables	100	160	170
Erie Telephone	100	65¾	66¼
New England Telephone	100	101½	..
Postal Telegraph-Cable	100	92	94
Western Union Telegraph	100	86½	86⅞
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	17⅝	17⅞
Brooklyn Rapid Transit		19½	20
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	77	79
Cleveland Electric Ry	100	.	..
Columbus St. Ry	100	43	44
Hestonville	100	51	51¼
" pref		..	62½
New Orleans Traction	100	12	14
" " pref	100	42	45
North Shore Traction	100	22	24
" " pref	100	75	78
Rochester St. Ry	..	17	20
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	66¼	..
" " pref	100	87	..
Worcester Traction	100	19	21
" " pref	100	93	96
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	78¾	..
Buffalo St. Ry. 1st con. 5s	100	*107	..
Cleveland Elec. Ry. 1st mtge 5s	100	100	*103
*Columbus St. Ry. 1st 5s	100	95	100
Rochester St. Ry. 1st 5s	100	..	98
Union Railway (Huckleberry) 1st mtge 5s		*101	103½
*Westchester Electric 1st mtge 5s	100	100	103

* With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Dec. 14, 1896.

MR. S. E. SCHENCK has resigned his position with the C & C Electric Company to associate himself in business with Mr. Thomas J. Fay. They are New York agents and exclusive importers to Mexico, Central America, South America and the West Indies for the Crocker-Wheeler Electric Company.

OLD-TIME TELEGRAPHERS' ASSOCIATION.—We have received a copy of the proceedings of the sixth annual re-union of the Old-Time Telegraphers' Association which was held in Pittsburg, Sept. 9, 10 and 11 last. The proceedings are reported *verbatim*. The book contains half-tone illustrations of a number of old-time telegraphers and others, and at the back part is given a complete list of the members of the association.

"THE ELECTRICIAN."—A new four-act comedy drama entitled "The Electrician," will be brought out in the city after the new year. This play will, it is stated by Mr. Charles E. Blaney, its author, present some startling and realistic scenes. The three principal subjects of the drama are electricity, accident insurance and gold mining at Cripple Creek. In the second act dynamos in practical operation will occupy positions on the stage.

IMPROVED MOTIVE POWER ON SURFACE LINES.—It was decided at a meeting of the directors of the Metropolitan Traction Company, held on Dec. 8, to substitute some mechanical motive power in place of horses on the Fourth, Sixth and Eighth Avenues street railway lines. The particular system to be used, however, was not definitely decided upon, although it is stated that the underground trolley seems to be favored by a majority of the directors. The work of construction, it is said, will begin early in the Spring.

FOOTE, PIERSON & CO. announce that they have purchased the manufacturing department formerly owned and operated by The E. S. Greeley & Co., 5 and 7 Dey Street, New York, and have removed the same to 82 and 84 Fulton Street, where they will continue the manufacture of all electrical instruments and supplies formerly produced by the Greeley Company. The members of the new firm were associated with the Greeley Company for 25 years in its manufacturing department, and in continuing the business they will give particular attention to the designing and building of special electrical apparatus.

THE CONSUMERS' FUEL GAS, HEAT & POWER COMPANY, which was voted a valuable franchise by the New York Board of Aldermen, is likely to lose the grant after all. So much opposition has developed that it is thought the Mayor will veto the measure, and that the Aldermen will be unable to pass the franchise over the veto. The matter has also been brought before the courts. It is said that the company may endeavor to get a franchise from the Legislature. The Acetylene Company applied to the Legislature for practically the same privileges in New York City, but the Assembly Committee on Gas, Electricity and Water Supply, which kills more bills in a winter than it reports in a century, promptly put a quietus upon the application of the Acetylene Company.

INSULATED WIRES AND CABLES.—Mr. George L. Wiley, New York manager of the Standard Underground Cable Company, in referring to Mr. J. D. Bishop's articles on the "Construction and Design of Insulated Wires and Cables," which are now running in THE ELECTRICAL WORLD, states that the Standard Underground Cable Company owns a patent covering the type of cable suggested by Mr. Bishop on page 659, in the issue of Nov. 28. Mr. Bishop there states that previous considerations "would seem to point to a combination cable, composed of a dry paper core with rubber compound sheathing enclosed in the usual lead pipe." The patent referred to by Mr. Wiley was issued on March 17, 1891, to Mr. William A. Connor, of Pittsburg, Pa., and is numbered 448,604.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
927 Chestnut Street,
PHILADELPHIA, Pa., Dec. 12, 1896.

MESSRS THOS. C. WARLEY & CO., 11 South Ninth Street, manufacturers of boiler-cleansing compounds and lubricating oils and greases, are having prepared a very handsome and unique catalogue for 1897, which will be mailed to interested parties upon receipt of their name and address.

MESSRS. JOHN Y. PARKE & CO., manufacturers of electrical and gas lighting appliances, report that they are receiving quite a number of orders for their burners, many of which are from the extreme West. They are preparing a neat little price list, which will include descriptions and prices of their various burners and fittings, including their pendant and automatic devices for lighting Sunlight gas lamps, Welsbach burners and similar incandescent lights.

MESSRS. EYANSON & ARMPREISTER, manufacturing electricians, 123 North Third Street, have just been awarded a contract for the switchboard in-

stallation for the Mexican International Railroad of the City of Mexico, and also for the municipal lighting plant of Yokohama, Japan. They are about finishing a large board fer the Liondale Bleach, Dye & Paint Works at Rockaway N.J. This is probably the largest board of its kind in this country, as it controls all the current for power of the entire works, this plant using electric distribution for power.

THE NEWTON MACHINE TOOL WORKS are now working on a large contract for the Brazilian Government, to equip its railway shops with milling machines, cold saw cutting-off machines, boring machines and special tools. These machines will be ready for shipment in about four weeks. They are now preparing a new illustrated catalogue containing about 200 pages showing their very latest machines and omitting the antiquated ones. Their contract for the Russian Government has recently been filled and shipped, also their contract for Germany.

MR. HENRY CLAY'S SEAT IN THE CITY COUNCIL.—The Municipal League proposes to test the right of Henry Clay to sit in select council from the Sixteenth Ward while he is at the same time interested in contracts for public lighting. Mr. Clay's ability is not questioned but his connection with the electric light industry is considered to be prejudicial to his position in the Council, and there is good warrant, it is stated, for assuming, with the De Camp case as a precedent, that the law as well as propriety forbids the exercise of such dual relations as is alleged in this case. Mr. Clay is vice-president of the National Electric Light Association and general manager of the Northern Electric Light & Power Company, Philadelphia. He has figured prominently in the public affairs of that city for a great number of years, and is highly esteemed.

THE ELECTRICAL MAINTENANCE COMPANY opened its office in Philadelphia in September, 1895, for the purpose of writing contracts for the regular weekly expert examination of electrical installations and the yearly maintenance of same for a small annual fixed charge Since that time the Philadelphia manager, J. W. Cregar, has written 158 contracts with the best houses, these contracts covering 685 machines. It has not one dissatisfied customer on its lists. Its patrons renew their contracts with them as fast as the old contracts expire. It has some of the largest plants in the city covered by its maintenance contracts, and continues to write new ones every day. It has one of the best equipped shops for electrical work to be found in the city, employing 25 skilled electricians, and prepared to do all kinds of electrical repair work in the shortest time and guarantee all work to be strictly first class in every way. Its experts have more than a local reputation.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., Dec. 12, 1896.

PRESIDENT H. C. HAWKS, of the Anchor Electric Company, Boston, has just returned from a business trip to New York, Philadelphia, Baltimore and Washington, securing his usual success in the way of good sized orders.

MR. F. S. PALMER, manager of the Electric Heat Alarm Company, Boston, was united in marriage Nov. 30 to Miss Nettie Lauretta Schultz, of North Cambridge, Mass. Cards announce "At home after Dec. 9 at 56 Frost Street, North Cambridge." Mr. Palmer has a wide acquaintance and popularity in the electrical field, and all with us will wish for him and his charming bride all possible blessing, happiness and prosperity.

THE ELECTRICAL POTENTIAL of Boston will hold its first meeting of the season of 1897 at the Hotel Thorndyke, on Dec. 23. At this meeting Mr. J. W. Kellogg, manager of the marine department of the General Electric Company, will speak on applications of electricity to marine and naval uses. The paper will be illustrated with lantern projections of prominent and interesting installations of apparatus. It is also expected that a number of new devices will be shown in operation.

MESSRS. G. A. FREI & CO., of Boston, have recently issued a catalogue of their X-ray apparatus, in which is offered a full line of Ruhmkorff coils of high grade, and also static machines for the generation of X-rays. These machines have the advantage that they cannot only be used for X-ray work, but for all kinds of demonstrations in static electricity. The Crookes tubes and fluoroscopes made by this firm have elicited most flattering testimonials from all parts of the country.

MR. W. H. LOW, of the Electric Appliance Company, Chicago, was a Boston visitor this week in company with Mr. H. O. Phillips, president of the Phillips Insulated Wire Company, Pawtucket, R. I., of which the Electric Appliance Company is Western representative, representing also the Standard Thermometer & Electric Company, Peabody, Mass. Much interest is manifested in the new long-burning lamp now being introduced by the Standard Company.

MR. C. R. FISH, well and favorably known as one of the old T.-H. staff, who has been particularly prominent in central station work, and for the past few years general manager of the Suburban Light & Power Company, Boston, bringing it up to a high plane of excellence and success, has become connected with the New England office of the Fort Wayne Electric Corporation. There are abundant reasons for mutual congratulations on the part of all—the Fort Wayne Electric Corporation, Mr. E. I. Garfield, its New England manager, and Mr. Fish.

THE FRANK RIDLON COMPANY, Boston, has opened an office in New York, and arranged with Mr. Charles N. Wood to look after its interests there. Mr. Wood, however, will still retain his office in Boston, at 31 State Street. He finds it necessary to spend the greater part of his time in New York, and with his large and favorable acquaintance among users of electrical machinery he is sure to increase and extend the business of the Ridlon Company and of his own as well—the two being practically combined. The large repair shop of the Frank Ridlon Company, in Boston, insures practically a factory inspection and guarantee of all the apparatus sold by it.

MESSRS. WILLIAMS, COUCH & WHITMAN, No. 196 Summer Street, Boston, have made the telephone exchange business far more satisfactory as well as profitable through the instruments they manufacture. The Swedish microphone used on all of their instruments is guaranteed indefinitely, and practically never packs or loses its efficiency, which is very high. They have become the sole selling agents in the United States through Messrs. Smith & Patterson, of New York, for L. M. Ericsson Company's Swedish microphones, and with their increased facilities are capable of filling large orders on short notice. On some of the exchanges equipped with this apparatus there are grounded circuits of between 20 and 30 miles with as many as 16 instruments in series, giving excellent service.

THE MOSSBERG & GRANVILLE MANUFACTURING COMPANY, who has acquired all the rights, title and business of the Mossberg Manufacturing Company, formerly of Attleboro, Mass., has removed its plant to the new Kent & Stanley Building, 101 Sabin Street, Providence, R. I. Here it occupies a floor space of more than two acres, filled with the most improved machines, while the entire concern is modern in every respect. The company has been long and favorably known to the machinery and jewelry trades, but is now building a line of tools which is especially adapted to the needs of the electrical trade. All sheet metal punchings and stampings, such as armature plates, incandescent light sockets, stamped ceiling caps, in short, every similar device, can be made rapidly and economically by its presses and methods of manufacture.

THE H. N. BATES MACHINE COMPANY, Boston, may certainly regard with satisfactory pride its handsome new factory at Nashua, N. H., now almost completed. The factory is three stories in height and 130 x 50 feet in dimensions. It is located directly on the line of the Boston & Maine Railroad, affording excellent advantages for receiving and shipping goods, and in appearance is decidedly attractive. Its interior is convenient, with abundance of light for manufacturing purposes. All the machinery is not yet installed, but will be by Jan 1, 1897. The Bates motors and dynamos have already acquired an enviable reputation, and with the increased facilities of the new factory the trade will have no reason for complaint as to prompt fulfillment of orders. Another branch of manufacture from this new factory will be that of pulleys, hangers and shafting. The Boston factory of the company will still be retained for light work, but all the heavy work will be conducted at the Nashua factory. In power transmission machinery Mr. H. N. Bates has had a long experience, and it should be a matter of gratification to himself and his numerous friends that his successful business career should be crowned with such evidence of prosperity as is represented in this new factory. Mr. L. I. Fletcher, manager of the electrical department of the company, has reason also for gratification, as this plant is mainly due to the popularity of electrical apparatus of his design, which being now a large part of the business of the H. N. Bates Machine Company, demanded extra manufacturing facilities. Mr. Fletcher was for a number of years identified with the Lowell (Mass.) Electric Light Company as its general manager, and is as well known to the electrical trade as is Mr. Bates in the line of power transmission.

Buffalo and Niagara Falls Notes.

Buffalo, N. Y., Dec. 11, 1896.

NIAGARA PAN-AMERICAN EXPOSITION, 1899.—Capt. Brinker, of the Gorge Road, said the Pan-American Exposition that is to be held here in 1899 will be one of the grandest that was ever held in this country, and all the nations of the earth will be represented. He did not care to say where the exposition would be held; the land had been bought, however. The committee having the matter in hand will later on issue a pamphlet in which will be told the sites, number and kinds of buildings to be used and other details connected with it. It is the intention of the projectors to begin early in the Spring the work of laying out the grounds and arranging for the building of the halls in which the exhibits will be shown.

CONVENTION HALL.—At a recent meeting of the Power Celebration Committee, it was decided to prepare and circulate for signatures petitions to the Common Council, asking that body to request the representatives in the Legislature to pass a bill authorizing the city to expend a sufficient amount in the construction of a large hall for the primary purpose of providing suitable accommodations for the next annual meeting of the American Street Railway Association, which will be held in this city in October, 1897. The hall is to be of a substantial nature and will be a permanent institution. There is considerable enthusiasm over the subject and it is proposed to do everything possible to make the meeting a success in every way.

THE CARBIDE COMPANY is pushing work on its new plant at Merritton, Ont., which is located on the Welland Canal about six miles back from the river. Power for the plant is derived from the canal, in which there is not only an abundance of water, but also a good fall. The company has erected a good sized power-house, in which has been installed two 500-hp General Electric generators with stationary armature coils and revolving field magnets. These are driven by two Leffel water-wheels of the Sampson type, with a capacity of 1200 horse-power. The flume which conveys the water to the turbines is 40 feet long by 18 feet wide and with an average depth of 7½ feet. The electrical furnace room at this plant has accommodations for 15 furnaces for fusing. With this number in operation the average output will be from 10 to 12 tons per day. Mr. Thomas L. Willson, the inventor of the carbide process and the head of the company, announces that he will make important extensions to the plant during 1897 and will erect a laboratory. He will also establish a plant at Quebec.

BUFFALO ELECTRIC BANQUET.—At a meeting held a few days ago to consider the Buffalo celebration, Mr. George Urban, Jr., stated that the company of which he is president, the Cataract Power & Conduit Company, contemplated giving an elaborate banquet at the Ellicott Club some time in January, to which as many prominent people as possible would be invited, including if possible the President-elect of the United States. The Conduit Company would, he said, defray the expenses of this banquet, and it remained for the people of Buffalo to say what further should be done for the celebration. Later in the meeting he said it was very likely that the electric current would, in some manner and by some device, be transmitted from Niagara Falls to one of the dining tables at the banquet, and that President-elect McKinley would have the opportunity if present of touching the button that should set

the current toward Buffalo. This proposition met with general favor and was formally approved by an appropriate resolution. A grand illumination will be made from the Ellicott Square Building. Fifteen or 20 search lights will probably flash their beams of light from the roof of this building, making many fantastic figures.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, ILL., Dec. 11, 1896.

COL. J. H. SHAY, of the Philadelphia office of the Munson Belting Company, is touring the West on an extensive business trip.

MR G. S. HOKE, manager for Messrs. Berthold & Jennings, St. Louis, who are the largest dealers in white cedar poles and oak ties in the State of Missouri, was in Chicago during the week. He reports a decided improvement in business since the election.

THE WESTERN SUPPLY TRADE is delighted over the establishment of the Bryant Electric Company's new factory at East Liverpool, O. The advantages accruing to the electrical supply houses of the West as the result of this new departure—by which the Bryant Company practically becomes a Western institution—are so obvious and apparent that Mr. Bryant must be saying to himself: "Why didn't I think of it before?"

MR. C. E. WOODS, formerly chief electrician for the Standard Electric Company of Chicago, has for some little time been engaged upon special consulting engineering work for the Northern Electrical Manufacturing Company, Madison, Wis. In a former issue it was inadvertently stated that he was to act as engineer-in-chief of the latter company. Mr. Woods is well known for his excellent work in designing some recent types of electric vehicles.

GOLD MEDAL FOR MR. BARRETT.—City Electrician John P. Barrett has received from the German World's Fair Commissioners a gold medal, as an honorary reward for the work done by Mr. Barrett at the Columbian Exposition. The medal is solid gold, four inches in diameter. On the obverse side, around the German coat-of-arms, is the inscription "Columbian Exposition in Chicago, 1893," and on the reverse side are the words "John P. Barrett, in grateful remembrance."

BRIDGING BELLS.—Mr. J. E. Keelyn, president of the Western Telephone Construction Company, has offered rewards for proof of use prior to August, 1888, of bridging bells in telephones of the so-called "Carty" type. The proof should cover the following points as fully as possible: Place where bridging bells were used; resistance of ringer magnets; drawing of circuit connections; name of manufacturer; name of user; date seen in use, and the names of any persons who could testify to the same. The names of the informants will be kept secret unless there is no objection to making their names public.

MR. CAMPBELL SCOTT, general manager of the Louisville Electrical Works, Louisville, Ky., manufacturers of the Phœnix transformer, is disposing of his interest in that concern, and will sever his connection with it on Jan. 1 next. Mr. Scott has not yet determined as to what electrical interest he will connect himself with for the future, but has decided to leave Louisville for a field offering greater advantages. Having been actively engaged in the different branches of the electrical business for some 10 years, Mr. Scott has gained a wide and extended experience which cannot but prove of great value to whatever interests he becomes associated with.

ST. LOUIS NOTES.

ST. LOUIS, Dec. 10, 1896.

ARRANGEMENTS FOR CONSTRUCTION.—Arrangements for the construction of the electric railway from Carondelet to Fenton, Mo., this Winter, will be made immediately.

COURT ORDER.—The St. Louis & Meramec River Railway Company has been ordered by the County Court to place the poles of its line 25 feet from the centre of its road, and the Bell Telephone Company and Postal Telegraph Company have been ordered to do the same thing along the line of the road.

NEW UNDERGROUND CONDUIT COMPANY.—The Underground Telegraph & Telephone Company was granted a franchise by the City Council to construct underground conduits in which to place its own and wires of other companies. This is the same bill with a few changes that was passed a short time ago and vetoed by the Mayor and which the Supreme Court declared to be unconstitutional.

THE EDISON COMPANY WANTS A NEW DEAL.—The Board of Public Improvements received a communication from L. B. Pike, secretary of the Edison Illuminating Company, requesting a reconsideration of the orders adopted 60 days ago forbidding the company to continue changing its lamps from the direct to the alternate current. He claimed that the alternating-current lamps had been greatly improved and the company wanted to get its lamps all on one system.

CITY ELECTRIC LIGHT PLANT.—Some of the city officials are in favor of the city having its own electric lighting plant. A plan suggested is to have trustees appointed to issue bonds and build and operate a lighting plant, the city to give these trustees the contract for lighting the city at a moderate price, the proceeds to be used in forming a sinking fund for paying off the bonds. When the bonds are paid off the trustees are to deed the plant and equipment to the city.

FAILED TO FILE BONDS.—Five of the 17 applicants for space in underground conduit for electric wires have not filed their bonds of $50,000 as required by ordinance, and three of them have not filed the formal acceptance, as required by law. The delinquents are the Trans-Mississippi Electric Company, the Laclede Power Company, the Postal Telegraph-Cable Company the American Telephone Company and the Bell Telephone Company. There is a difference of opinion as to bonds being required, and the city counsellor may be called on to give his opinion. Some of the companies may be sent out on this account. It will, at all events, eliminate speculators.

NEW TELEPHONE COMPANY IN THE FIELD.—The three big companies which organized last Saturday promise to play an important part in the telephone and electric business here. They are the Kinloch Telephone Company, of Missouri, capital, $1,500,000; the Citizens Electric Light & Power Company capital, $750,000, and the St. Louis Electrical Construction Company, capital, $600,000. They are backed by local capital and their combined objects are to fight the Bell Telephone Company, to build an electric light plant and general electrical works and to furnish electric light and power for municipal or private use. Although the three corporations are separate organizations, the stockholders are identical. The only foreign stockholders are James T. Parish, New York capitalist, and Hopkins J Hanford, of Evanston, Ill. The three companies held a meeting Tuesday and the organization of each was perfected. The combine will make preparations at once for the building of a central exchange and conduct a general telephone business, the rates to subscribers being for residences $36 per annum; physicians, $50 per annum, and business offices, $60 per annum

General News.

NEW INCORPORATIONS.

THE PHILADELPHIA INSULATOR COMPANY, Philadelphia, Pa., has been incorporated in West Virginia with a capital stock of $1000 minimum and $250,000 maximum The incorporators are H. W. Rappelye, J. W. Fitzpatrick and S. B. Rappelye.

THE ELECTRICAL EXCHANGE, Chicago, Ill., has filed articles of incorporation. The object of the company is to deal in electrical apparatus and supplies. Those interested are Thaddeus S. Lane, Ralph R. Lane and Cora L. Clasner. Capital stock, $10,000.

THE CARLISLE ELECTRIC LIGHT, HEAT & POWER COMPANY, Carlisle, Pa. has been organized with a capital stock of $1000. The directors are M. P. Quinn and W. Waldenger, of Pottsville; Charles J. Quinn, of Shenandoah; J. C. Bucher and W. G Mullin, Boiling Springs.

THE WARD ELECTRIC SUPPLY & CONSTRUCTION COMPANY has been incorporated in New York City, N. Y., with a capital stock of $15,000. The incorporators are Olin S. Greene, Clifton, S. I; Charles O'Keefe and Deronda Levy, New York; R. H. Dikeman, of Newark, and Thad. T. Grover, of Brooklyn.

TELEGRAPH AND TELEPHONE.

ALEXANDRIA, TENN.—A telephone exchange in this place is one of the future possibilities.

ERIE TELEGRAPH & TELEPHONE COMPANY made a net gain of 128 subscribers in November and 2525 for the 11 months of 1896. Total number connected Dec 1, 21,116.

KNOXVILLE, TENN.—It is proposed to introduce a system of police telephone signals, and it is stated that the Knoxville Street Railway Company will allow the city the use of its poles free of charge.

KOKOMO, IND.—It is stated that the new telephone company here will decrease its rates, making them $2 50 per month for business purposes and $1 00 per month for residences. The old rates were $3 and $2, respectively.

NEW ALBANY, IND.—The Ohio Valley Telephone Company has received the right of way to extend its line from Leavenworth to English, which will give the latter place communication with New Albany and Louisville.

MIDDLEBURG, KY.—The extension of the telephone line from Dunville to Russell Springs, there to connect with the lines to Campbellsville, is assured. The line to be so extended is the Hustonville & Green River system, and when the extensions are completed the line will have a total length of 75 miles.

WAYNESVILLE, ILL.—The Citizens' Telephone Company, of Waynesville, is now making surveys for a line from this place to Clinton, by way of Beason, Midland City and Hallsville, a distance of 27 miles. It is expected that the work will be completed by Feb. 1, 1897. Mr. B. F. Wasson, Lincoln, Ill., is superintendent of the company.

DES MOINES, IA.—Alderman Garver favors the idea of having the city own its own telephone plant, and wants the city to step in and assume control of the Mutual Telephone Company's franchise. From another source comes the information that a contract has been signed between the Mutual Telephone Company and the Connecticut Telephone & Electric Company, of Meriden, Conn., for the construction of long-distance lines and a switchboard for the Des Moines exchange. The company, it is stated, will commence work in the Spring, having secured the necessary number of subscribers to warrant its commencing active work

ELECTRIC LIGHT AND POWER.

GRAND JUNCTION, IA.—Steps are being taken to establish an electric light plant.

ANGELICA, N. Y.—The residents of this place are talking favorably of putting in an electric light plant.

NEW PRAGUE, MINN.—A private company headed by F. J. Melounek proposes to establish an electric light plant.

SYRACUSE, N. Y.—It was resolved by the City Council that the city should construct and own its electrical subway plant.

THREE OAKS, MICH.—Three Oaks has called a special election to vote on the question of raising money to build electric light works.

OLNEY, ILL.—The Council has under consideration the matter of municipal lighting. The contract with the present company expires next June.

IONIA, MICH.—The Ionia Electric Light Company has asked for a five-year extension of its franchise. If granted, it is proposed to obtain power by building a new dam on Grand River above Lyons.

DES MOINES, IA.—The Council authorized the Lighting Committee to advertise for bids for an electric light plant for the city. The city engineer submitted an estimate of the cost of constructing and maintaining an electric light plant in the arc light district. The cost is $32,000 for maintenance. The plant calls for 208 arc and 180 incandescent lights.

A LARGE WATER POWER.—The report that has been current for some time concerning the development of a large water power exceeding even that of Niagara, seems to have some basis in fact. The plan contemplates the development of no less than 100,000 horse-power, by the diversion of a portion of the St. Lawrence River at the town of Massena, St. Lawrence County, New York State. It is proposed to create an artificial fall by diverting a portion of the stream to another channel at a point where the topography is such that a canal less than four miles long, over easy country, will give a fall of about 50 feet. The Grass River flows parallel to the St. Lawrence, which is only three miles away, and discharges into the latter at a point seven miles below. In this distance the St. Lawrence falls about 100 feet over the Long Sault rapids, but the Grass River falls only 50 feet in the same distance, so that its level at Massena is about 50 feet below that of the St. Lawrence at a point three miles due north. A canal three and one half miles long will bring the St. Lawrence water to the limestone bluff on the north bank of the Grass River, where it will have a sheer fall of 50 feet to the river below. The canal as proposed will be 200 feet wide, and will discharge 1,000.000 cubic feet of water per minute under a head of 50 feet. It is stated that the cost of the canal will be less than $1,000,000, and according to the present plans most of the power will be utilized on the spot by wood pulp mills and a calcium carbide plant. It is intended to install 10,000-hp dynamos direct-connected to the spindles of turbines of the same output, which, under the comparatively low pressure used, it is stated, will involve less engineering difficulties than the 5000-hp units at Niagara. The plans contemplate electrical furnaces of 1000 and 2000 electrical horse-power. Messrs. Stewart & Co., Wall Street, New York City, are the projectors of this enterprise, and Lieut. F. Jarvis Patten is the consulting engineer.

The Electric Railway.

MEDIA, PA.—An effort is to be made to have the proposed Media, Middletown & Ashton Electric Railway built soon.

HARRISBURG, PA.—The directors of the Harrisburg Traction Company are discussing plans for the erection of their new Third Street car house.

ALBANY, N. Y.—The State Railroad Commission has granted the application of the Greenville & Schuylerville Electric Railway Company, to construct its road.

RICHMOND, VA.—The Richmond Traction Company applied to the Street Committee for permission to build a line from Broad Street along Brook Avenue to the city limits.

ATLANTIC HIGHLANDS, N. J.—It is said that George H. Stout, Jr., of this place, is at the head of a scheme to run the trolley to this place and connect with boats to New York.

CLEVELAND, O.—It is stated that the Cleveland & Elyria Electric Railway Company is considering the advisability of extending its road from Elyria to Oberlin, a distance of nine miles.

ALBANY, N. Y.—The Albany Railway will establish a new belt line by connecting the Clinton Avenue, Gates, State Street and Central Avenue routes. The line to Cohoes will be open in the Spring.

NEW YORK CITY.—The Third Avenue Railway Company has received permission to construct its double trolley line extension from 162d Street up Kingsbridge Road to and across Spuyten Duyvil Creek.

CHILLICOTHE, O.—The street railway of Chillicothe is to be improved at an expense of $15,000. The track will be extended 1½ miles, and the entire plant re-equipped with the latest and most improved machinery.

HAGERSTOWN, MD.—The Hagerstown Electric Railway officials were in consultation in Frederick, with a number of citizens of that place, on the subject of building an electric road from Middletown to Funkstown, a distance of 15 miles.

PLAINFIELD, N. J.—The extension of the line of the Plainfield Street Railway from Somerset Street to Mountain Park Inn on Watchung Mountain has been decided upon. The improvement will be made next Spring, and the citizens of Washingtonville will offer inducements if extensions are made by way of that town.

FREDERICK, MD.—It is announced that the construction of the road (recently surveyed) from Washington to Gettysburg, by way of Frederick, will be begun next Spring. The company is working under a charter known as the Baltimore & Washington Transit Company, and has the right to construct and operate throughout the State of Maryland. Capital, $1,000,000.

MARLBORO, MASS.—A street railway company has been formed to construct and operate a line nine miles in length, connecting the present systems in Framingham and Marlboro, running through Southboro. It is capitalized at $100,000. It will be known as the Framingham, Southboro & Marlboro Street Railway Co. The directors are S. H Howe, of Marlboro; F. D. Newton, of Southboro; J. R. Entwistle, of Framingham, and others.

Legal Notes.

NO INJUNCTION.—The Third Avenue Railway Company came out victorious in the injunction cases brought against it by the Metropolitan Street Railway Company and Thomas H. O'Connor, a taxpayer, to restrain the company from building on the Kingsbridge route. The application was denied by Judge Truax, of the Supreme Court.

JUDGMENT REVERSED.—The Appellate Court has reversed the judgment of the lower court in the case of the guardian of five-year-old Clara Rost against the Brooklyn Heights Railroad Company, and a new trial has been ordered. The child was run over by one of the company's cars, and the injuries received necessitated the amputation of one foot. During the trial the amputated foot of the child, preserved in a glass jar, was submitted as part of the evidence. The railway company contended that exhibits of this character were calculated to arouse the sympathy of the jury, and in the opinion of the justices these exhibits prejudice a jury in rendering their verdicts. The judgment was therefore reversed.

Personal Note.

Mr. CHARLES E. BROWN, one of the pioneers in the central station business, has resigned his position in the sales department of the C & C Electric Company, with a view to taking up special work.

Trade and Industrial Notes.

THE KENT ELECTRIC MANUFACTURING COMPANY, Worcester, Mass., has just issued a neat catalogue of its alternating-current motors, battery motors and light power specialties.

THE RHODE ISLAND TOOL COMPANY, Providence, R. I., has placed the contract for its new galvanized room with the Berlin Iron Bridge Company, East Berlin, Conn. The building will be a fire-proof structure throughout, no woodwork being used.

MR H. F. FREVERT, of the Garvin Machine Company, New York, has just returned from a five-months trip through the large European cities. He was successful everywhere, and sent home orders of a size that will add materially to the exports of American machinery in the next few months.

LARGE CONTRACT.—The Lancaster Caramel Company has just closed a contract with Deen & Schaum, of this city, for a 150-hp Ideal engine, 100-kw Card generator and a 54-hp Card motor. Two 20-hp motors will also be installed. This contract is said to be the largest one ever let in this section of the country.

ENLARGING ITS PLANT.—The Kearney Electric Light & Power Company, Arlington, N. J., will enlarge its plant by the addition of a brick extension, plans for which are being prepared. The company is in the market for an engine and alternator. Manager George F. Woolston has charge of the purchases.

THE HOPPES MANUFACTURING COMPANY, Springfield, O., manufacturer of live steam feed-water purifiers and exhaust-steam feed-water heaters, reports a large increase in business during the last few weeks, having filled in a short time 30 orders, aggregating about 9000 horse-power of heaters and purifiers.

THE CHICAGO GENERAL FIXTURE COMPANY, 169 Adams Street, Chicago, has taken the agency of the Clifton iron armored conduit, which is meeting with favor and a large demand in Eastern cities. It is stated that this conduit has been approved by the National as well as the State Board of Fire Underwriters.

THE D. M. STEWARD MANUFACTURING COMPANY, Chattanooga, Tenn., manufactures a complete line of lava electric insulators, gas tips, etc. The company reports that it has received from one gas company in New York alone orders for 1500 gross of Stewart's special gas burner. The company's goods are growing in favor and demand.

CHARLES J. BOGUE, 206 Centre Street, New York, reports a large and increasing business in the line of refilling commutators, reconstructing, repairing and rewinding the same. Mr. Bogue's catalogue and price-list of American dynamos and lamp parts gives complete illustrations of every part entering into the construction of the arc lamp.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has during the last 30 days greatly increased its facilities for handling its extensive, growing business of electrical supplies. The new treasurer, Mr. William Carpenter Camp, has put additional capital into the business, and the prospects are excellent for a large increase in the volume of trade.

THE GARLOCK PACKING COMPANY, Palmyra, N. Y., manufacturer of high grade packings for steam, water, ammonia, gas, etc., claims to be without a rival in the matter of quality, durability and economy of its product. Samples, catalogues and prices will be furnished on application. The factories and principal office are at Palmyra, N. Y., and Rome, Ga.

THE CONNECTICUT TELEPHONE & ELECTRIC COMPANY, Meriden, Conn., is calling the attention of the trade to its telephone apparatus by means of a catalogue and price list just issued. The catalogue contains many illustrations which clearly show the various apparatus and parts manufactured by this company. Diagrams of telephone connections are also given, and at the back part of the book *fac-similes* of testimonials are presented.

MORE CONTRACTS.—The Jenney Electric Motor Company, Indianapolis, Ind., has recently closed a contract with W. E. English, of that city, for another large generator for his new hotel, this being the third machine furnished to Mr. English within the last three months. The company has also been awarded the contract for a second large generator for the Tyler Wire Works Company, Cleveland. The two 100-kw generators and 24 motors furnished the Chattanooga Foundry & Pipe Works by this company are installed, and admired by all.

FIVE SUCCESSFUL YEARS.—The Electric Appliance Company has just completed its fifth business year, and is congratulating itself on the results. It began business at its present location, occupying a part of the first floor of the building at 242 Madison Street, Chicago. Its business increased, demanding greater facilities from time to time, until now it occupies the whole building, and has a large basement and three large upper floors filled with valuable

stock. The company's supply line is very large and complete in every respect, and its line of specialties is among the most desirable controlled by any one supply house in the country.

"A FLAWLESS FILAMENT, with a polished, silvery surface," was one of the illustrations in the advertisement of the Bryan-Marsh Company, New York, in the Dec. 5 issue of THE ELECTRICAL WORLD. Instead of the cut of the "polished, silvery surface" of the Imperial filament, there was inadvertently substituted in the first few copies of the paper printed the illustration of quite another filament. The oversight was soon discovered and the proper

cut, which accompanies this correction, was inserted in the remaining copies of the edition. The illustration shows the smooth and uniform character of the Imperial filament as it appears when magnified.

THE C & C ELECTRIC COMPANY.—Catalogues usually do not contain anything more than dry hard facts, but the C & C Electric Company, New York, has discovered a way of making its own catalogue interesting in the manner in which it presents to the trade the descriptions of its various products. Its new catalogue, just out, besides describing the C & C electrical apparatus gives much information of value to the engineer. The descriptive matter of the apparatus is well composed and the illustrations are of high quality. The company's alternating-current dynamos are of recent production; they are of the inductor type. C & C direct-current motors and dynamos and other apparatus are well known, the company being one of the oldest in the trade.

BIRDSALL NOVELTIES.—The electrical novelties manufactured by the Birdsall Electric Manufacturing Company, 231 Broadway, New York, constitute some of the rare electrical devices that make very desirable holiday presents. Electricity is generally associated with dynamos, electric railway, telegraphs and other industries which do not directly touch the pleasant side of life, but the Birdsall Company effects a union of the two, and its apparatus presents some attractive features. Its jardinieres and flowers are handsomely designed, with tiny electric lights sparkling amid the leaves and flowers. These goods are made in all styles and in many designs, the current for the lights being produced by the Birdsall dry battery placed in the base. The company also makes a line of electric cigar lighters, night clocks, advertising devices of all kinds, portable lamps, etc., all of which derive their operating current from dry cells concealed from view. The company's large line of electrical novelties should be seen to be appreciated.

AMERICAN ENGINE COMPANY'S DYNAMOS AND MOTORS.—That the dynamos and motors manufactured by the American Engine Company, Bound Brook, N. J., are making many friends is evident from the list of the company's November shipments given below. It will also be noted that the product of the company is being widely distributed. The shipments are as follows: *Syracuse Post*, Syracuse, N. Y., 18-kw dynamo; *Evening Star*, Washington, D. C., 50-kw dynamo; *Springfield Union*, Springfield, Mass., 25-hp motor; *New York Tribune*, New York City, 12-hp motor; *Peoria Herald*, Peoria, Ill., 12-hp motor; *Duluth News-Tribune*, Duluth, Minn., 12-hp motor; *St. Paul Pioneer Press*, St. Paul, Minn., 5-hp motor; *The Morning News*, Savannah, Ga., 25-kw dynamo; *Salem Daily Gazette*, Salem, Mass., 5-hp motor; *Chicago Journal*, Chicago, Ill., 12-hp motor; *Boston Daily Post*, Boston, Mass., 50 hp motor; *Kansas City Star*, Kansas City, Mo., 75-kw dynamo; W. D. Boyce & Co., Chicago, Ill., 12-hp motor.

Business Notices.

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BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

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Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 8, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

572,539. ELECTRIC ARC LAMP; C. Goodyear, Jr., New York, N. Y. App. filed Oct. 16, 1895. An arc lamp comprising two carbon holders, feeding mechanism having two adjustments, the one feeding the carbons substantially uniformly and the other feeding them differentially or at different rates, and means for changing from one adjustment to the other at will, whereby the said lamp may be converted at will to alternating-current or constant-current operation.

572,561. ELEVATOR SIGNAL APPARATUS; S. B. Opdyke, Jr., Philadelphia, Pa. App. filed April 24, 1894. In an elevating apparatus, the combination with a source of electric current supply, a normally open circuit, contacts in said circuit normally in contact, of an elevator car, a signal carried by said car, a device carried by said car, and adapted in the movement of said car to separate said contacts and include the signal carried by said car in said circuit, and means independent of the car to close said circuit.

572,562. ELEVATOR SIGNAL MECHANISM; S. B. Opdyke, Jr., Philadelphia, Pa. App. filed Oct. 8, 1894. In combination with an elevator car provided with a signal and mechanism for operating the car, of a series of contacts corresponding to, but not located at, the floors, a brush common to all the contacts, said brush being located outside and detached from the car, and means to give a relative movement between the contacts and brush, corresponding to the movement of the elevator car relative to the floors, normally open circuits including the brush, the signal and each of the contacts, and a circuit-closing device at each floor whereby when the circuit is connected at any floor and the brush makes connection with the corresponding contact the circuit is completed to the signal.

572,563. ELEVATOR SIGNAL APPARATUS; S. B. Opdyke, Jr., Philadelphia, Pa. App. filed Dec. 18, 1894. In combination with an elevator car and mechanism for operating the same, of a brush, and means to cause said brush to move proportionately with said car, devices consisting essentially of an electric magnet corresponding to each floor, and each provided with a spring-actuated armature, the spring acting against the magnet, a circuit to each magnet from its corresponding floor, a switch device at each floor including in the circuit to its corresponding magnet, normally open independent circuits, each including the armature of one of said last-mentioned magnets, the corresponding circuit being closed when its corresponding armature is retracted, contact devices by which the brush in its movement is adapted to include itself in the circuit, and electrical connection between said brush and a signal in the car.

572,607. ELECTRIC SIGNAL APPARATUS; G. Knowles, Milwaukee, Wis. App. filed July 19, 1895. In electric alarm or signal apparatus, the combination with a main circuit, including a receiving and a number of transmitting devices adapted to indicate the source of the alarms or signals, of means associated with each transmitting device for rendering it inoperative when interrupted by another, and thereby preventing interference or confusion of signals, such means comprising a branch circuit around each transmttting device, and a branch-circuit controller consisting of a rotary contact connected with the main circuit and movable synchronously with the associated signal-transmitting device, a movable contact in the branch circuit adapted to engage with said rotary contact, and means for automatically shifting said movable contact to close said branch circuit whenever the main circuit is broken, while the associated signal-transmitting device is "spacing."

572,609. TELEGRAPH SYSTEM; B. F. Merritt, Orange, N. J., and J. M. Joy, New York, N. Y. App. filed June 27, 1896 In a telegraph system, a line, two or more stations thereon, a transformer and a receiver at each of said stations, each operated by the corresponding transformer and a local battery, an electrical generator for supplying a constant current to said line, a driven rotary circuit-breaker in said line, and a transmitter connected with and controlling the motion of said circuit-breaker.

572,627. SYSTEM OF AUTOMATIC ELECTRIC REGULATION; W. L. Bliss, Brooklyn, N. Y. App. filed May 6, 1896. The method of automatically maintaining constant the E. M. F. on the translating devices in a working circuit supplied by a storage battery, and controlling the current and E. M. F. of the dynamo which charges said storage battery, consisting in demagnetizing the field of said dynamo by the charging current as the speed of said dynamo increases, and in increasing the resistance in said working circuit as the E. M. F. of said dynamo increases with increasing speed.

572,639. TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed Feb. 20, 1896. A method of inductively transmitting telegraphic signals between two telegraphic stations joined by a single-line wire or cable which consists in setting up or establishing at one station two sets of rapidly recurring primary current impulses, the secondary inductive effect of which is nullified upon the home receiving instruments, while the secondary current impulses transmitted to the distant station are caused to set up or establish tertiary current impulses which act upon receiving instruments located at that station.

572,668. RAIL BOND; I. B. Walker and L. G. Nilson, Sioux City, Ia. App. filed Sept 9, 1896. A rail bond or connection for electrical conductors consisting of a wire, rod, bar or strip of metal having terminal lugs, with a "V" or sector shaped portion cut away.

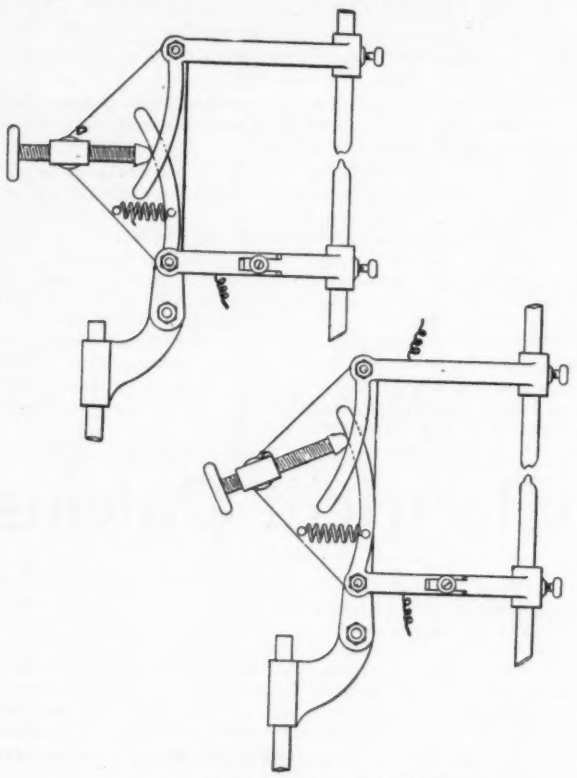
572,706. ELECTRIC RAILWAY; R. M. Hunter, Philadelphia, Pa. App. filed Nov. 4, 1886. In an electric vehicle, the combination of an electric motor mechanically connected to propel the vehicle, a reversing switch mechanically independent of the motor-brushes to reverse the polarity of one of the elements of the motor, motor circuits on the car for supplying current to the motor from a source of electric supply, a switch for cutting the

motor from the source of electric supply, and switch devices for short-circuiting the armature and field magnets and maintaining them in series to make the motor act as a generator to arrest or retard the movement of the car.

572,748. ELECTRICAL SWITCHBOARD; E. A. Fordyce, Chicago, Ill. App. filed Nov. 4, 1893. The combination with an electrical switchboard having a plurality of keys or circuit-closers and a controlling magnet having a connector common to the series of circuit-closers and electrical circuits corresponding in number to the circuit-closers at the keyboard, and normally open thereat, and each including the controlling magnet, and each of said circuit-closers having a controlling device or switch normally closed.

572,754 AUTOMATIC CIRCUIT-CLOSING DEVICE FOR GALVANIC BATTERIES. J. D. Holmes and W. L. Heath, St. Louis, Mo. App. filed Oct. 1, 1896. The combination with two or more cells of a battery connected in series of circuit-closing devices actuated by the rise and fall of the fluid of said cells for closing a metallic circuit through any cell when the fluid in it has fallen to a predetermined level.

572,756. TELEPHONE TRANSMITTER; R. L. Hunter and H. B. Higgins, Minneapolis, Minn. App filed May 23, 1896. The combination of a fixed base, its line terminals, the transmitter, and interlocking means for securing the transmitter to said base and electrically connecting it with said terminals.



No. 572,539.—Electric Arc Lamp.

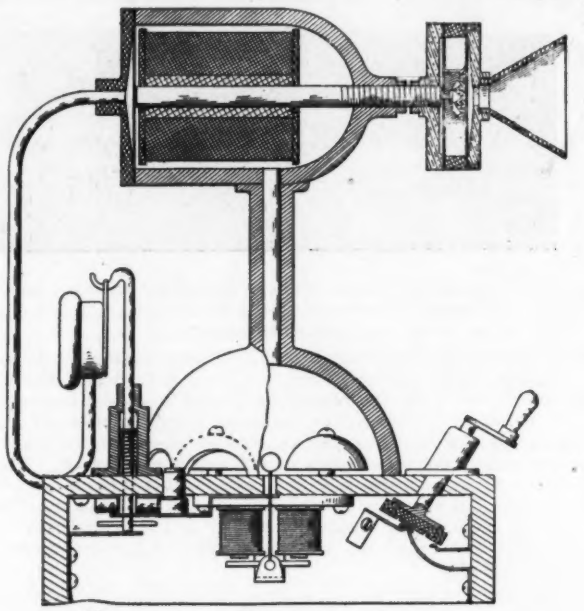
572,760. PRINTING TELEGRAPH; L Kamm, London, England. App. filed Dec. 30, 1895. In printing telegraphic transmitting or receiving apparatus, the combination of a series of spring-pins arranged in the arc of a circle, finger-keys connected to the said pins, a circuit-closing device in connection with the said keys, an arm arranged to work over the pins and provided with a movable hook projection and armature operatively connected, a magnet the armature of which is adapted to engage with the said hook and close the line-circuit, a weight or spring for operating the arm in one direction, a magnet for operating it in the other direction, a magnet for operating the armature on the arm, a series of type arranged in the arc of a circle and connected with the said arm, and a magnet the armature of which is arranged to close the line-circuit.

572,775. TELEPHONIC APPARATUS; C. J. Schwarze, Adrian, Mich. App. filed June 30, 1896. In a telephone, the combination with a microphone-transmitter, a transformer therefor, having primary and secondary windings with a magnetic core, and a battery in local circuit with said microphone and primary winding, of vibrating diaphragms arranged in proximity to the opposite ends of said core, the one being in mechanical contact with said microphone and the other forming the receiver, and means for pulsating or alternating the current in said primary winding to induce an alternating signal-current, and at the same time agitate the microphone material in the transmitter.

572,777. ELECTRIC ARC LAMP; T. Spencer & C. Toerring, Jr. App. filed May 6, 1896. A feed-regulator for an arc-lamp, comprising parallel pivotally-connected rods, a carbon-carrier mounted between the rods and engaging its facing sides only, a carbon pivotally supported thereby, a fixed guide-plate near the lower extremity of the carbon, and electromagnetic devices for causing the rods to approach or recede from one another under fluctuation of current.

572,801. TELEPHONE EXCHANGE; H. F. Hill, Cambridge, Mass. App. filed July 16, 1895. In a telephone exchange, the combination of an answering division, a distributing division, and line-circuits, each connected to two plugs, one plug at each division.

572,805. ELECTRIC LAMP; L. A. Jackson, New York, N. Y. App. filed July 25, 1896. An electric lamp comprising a metal casing, an incandescent lamp supported thereon, a battery comprising a series of cells within the casing, the shell of each cell forming a battery element, a cover for the casing, a rheostat supported by said cover, and having electrical connection through the casing with the lamp filament, a contact between said lamp filament and one of the cell-shells, and means for closing the circuit between the rheostat and battery.



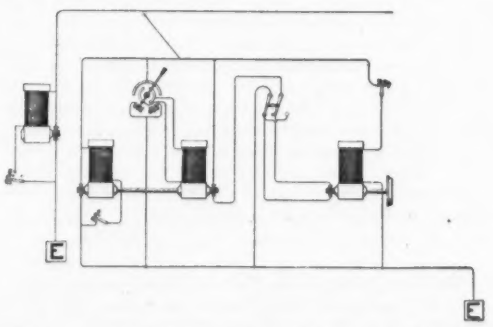
No. 572,775.—Telephonic Apparatus.

572,840. TELEPHONE SYSTEM; A. F. Swan, Bayonne, N. J. App. filed July 11, 1896. A telephone system comprising a series of telephones in circuit, a switch barrel for each telephone, each switch barrel having at its ends a plurality of insulating and conducting strips, the insulating strips of one end being out of alignment with the insulating strips of the other end, two pairs of brushes for each switch barrel, one being arranged to cut the telephone in and the other to cut it out of circuit, a pawl and ratchet mechanism operated by makes and breaks in the circuit to turn each switch barrel, and means, as a push button, for making and breaking the circuit.

572,903. REGULATING ELECTRIC MOTORS; H. W. Leonard, New York, N Y. App. filed June 24, 1892. The method of varying the speed of an electric motor, consisting in supplying the same with current from a source of constant E. M. F. in series with the current from a dynamo-electric machine whose field is variable and reversible, and in varying and reversing the field of said dynamo-electric machine to vary the E. M. F. at the motor from zero to a maximum.

572,923. AUTOMATIC CIRCUIT-CLOSER; E. C. Williams, Clarksville, Tenn. App. filed May 8, 1896. In an automatic circuit-closer, a fixed contact-point, a movable contact-point normally contacting with the fixed point and magnetically controlled in a direction away from said fixed point, an air-cup provided at one side with a flexible movable diaphragm, and at its opposite side with a normally closed leak-valve, and suitable connections between the flexible diaphragm and the movable contact.

572,933. TROLLEY FOR ELECTRIC RAILWAYS; H. A. Seymour, Washington, D. C. App. filed June 15, 1896. The combination with a trolley-pole, of an elongated support attached to the upper end thereof, a carrier adapted to travel on said support, and a trolley-wheel mounted on said carrier.



No. 572,903.—Regulating Electric Motors.

572,940. SUPPORT FOR TROLLEY WHEELS; C. F. L. Orth, New York, N. Y. App. filed April 16, 1896. The combination with the trolley arm of a trolley-car, of a trolley yoke secured to the end thereof, the sides of which are downwardly curved, a trolley-wheel mounted in said yoke, the shaft of which extends beyond the sides thereof, and a supplemental yoke mounted on said shaft, the end of which is connected with the ends of the sides of the trolley-yoke, and the sides of which are directed upwardly, and provided at the upper ends thereof with heads of wheels by which the space between said sides is closed.